computing today

MAY 1979

50p

One Up On Tape?
CompuThink Disc Reviewed

16K Ram Card For S100
Tunes On NASCOM1
TECS-How Good?
12 PAGE SOFTSPOT SPECIAL
Readers' Programs For You To Run

18K ON BOARD MEMORY!
5K RAM
5K RAM,3K ROM or 4K RAM, 4K ROM (link selectable). Kit supplied with 3K RAM, 3K ROM. Sysytem expandable for up to 32K memory.

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MM57109 Number Cruncher. Functions include +,–,*,/,squares,roots,logs, exponentials,trig functions,inverse, etc. Range 10

RESIDENT BASIC with extended mathematical capability. Only 2K memory used but more powerful than most 8K BASICS!

1K MONITOR resident in EPROM

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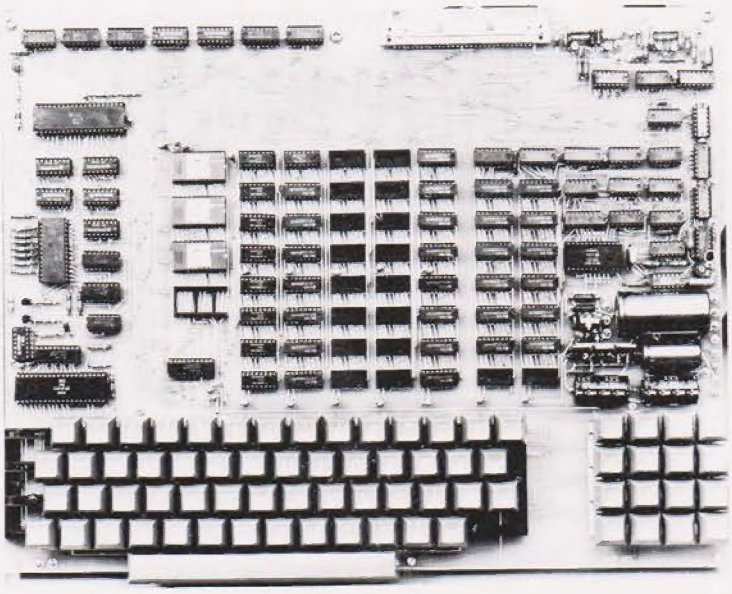
PCB size 16" x 12.5"



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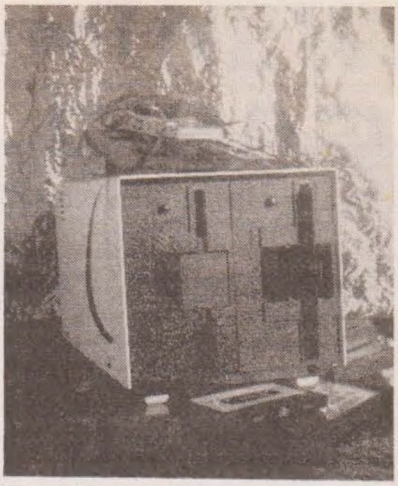
VOL 1. NO 3.
MAY '79



Compu/Think ? We do!

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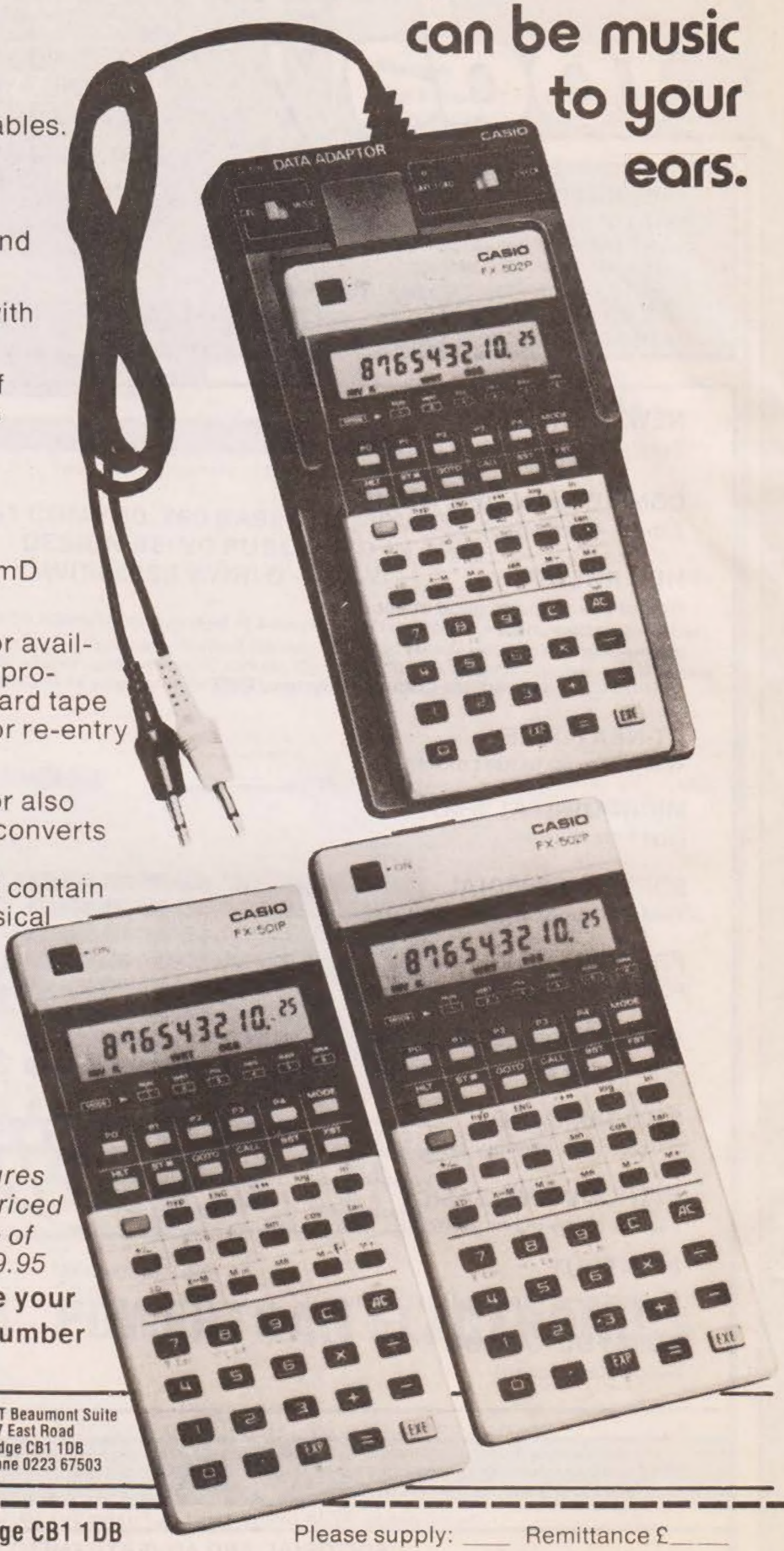

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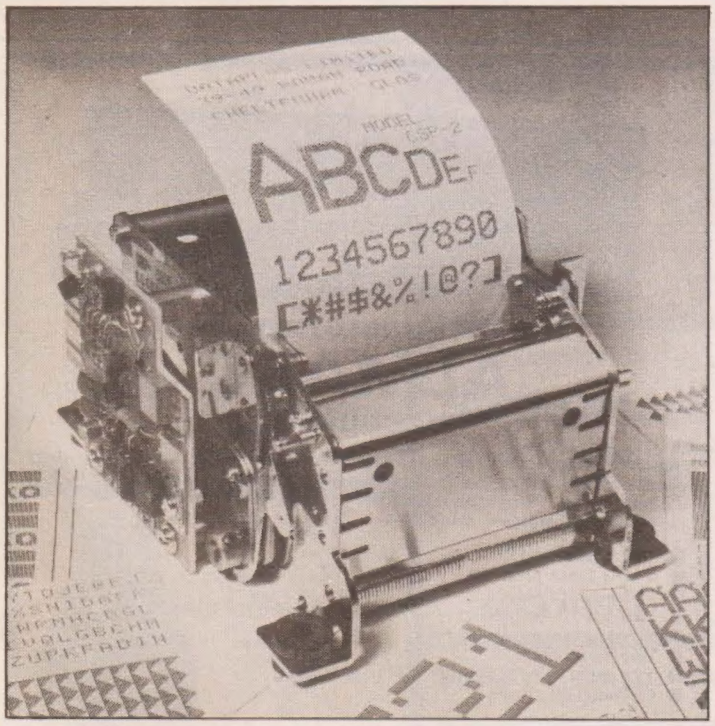
NEW SOFTWARE

Two new software catalogues arrived during the month. The first was the new Petsoft catalogue, bursting at the seams with new programs. These include 6 new Business packages, 8 new Educational and 8 new Games.The new catalogue is obtainable free from Petsoft,PO Box 9, Newbury,Berks. The second to arrive was from A.J.Harding, the TRS–80 software house. Again it's full of new programs as well as many tried and tested ones. One of the unusual features is the interspersion of tips on the TRS–80 which will be of great value to the user. Contact A.J.Harding at 28 Collington Avenue, Bexhill, East Sussex.

THE BYTE SHOP MOVES IN

The Byte shop have moved into London's West End, opening a new shop in the Tottenham Court Road. Among the currently stocked systems are the SWT 6800, the PET, Cromenco and Compucolor II. The policy is to equip from stock any level of user from the beginner right up to the small businessman. Other product held in stock ranges from program packages to hardware add–ons. For further information write to the Byte Shop, 426/428 Cranbrook Rd, Gants Hill, Ilford.



ELECTRO–PRINTER

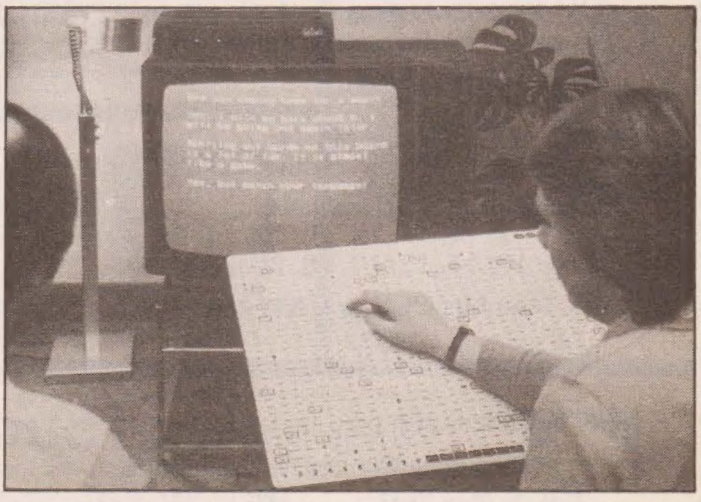
An electrosensitive paper printer in OEM form is available from Dataplus Ltd of Cheltenham. It can handle alpha's and graphics in any size and form, using a 120 pin multi–stylus head for printing. The unit is virtually silent in operation and prints at up to 400 cps, that is equivalent to 20 lines per second with 5x7 characters. Designed chiefly for the instrumentation market it can be built into terminals and point of sale units. The unit is 116 by 65 by 130 mm and weighs 1.1 Kg. For further data contact Dataplus on 0242–30030.

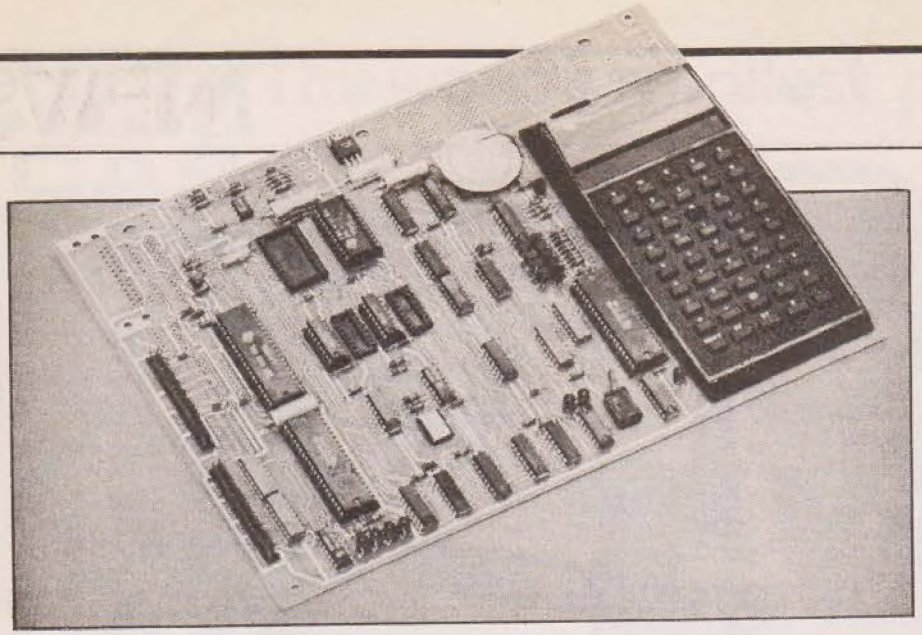
SPLINK HELPS DEAF COMMUNICATE

An electronic aid for the speech and hearing handicapped has been developed by Medelec of Manor Way,Woking. Tel 048–62–70331. The unit is micro based and has access to 950 of the most commonly used words in our vocabluary. The user can build up sentences from the keyboard and display them on a domestic TV. The main area of projected use is for the deaf or those with a dysphasic condition. 50 sets are currently under trial and it is hoped to go into production in the Autumn. It is also hoped to generate interest within the NHS.

COMART LAUNCH TWO

Comart have released two new versions of the Cromenco Z80A based processor. System 3/64 has dual 8" floppies and 64K of memory and comes with VDU and printer interfaces. Languages supported include COBOL, Extended BASIC and FORTRAN IV. Cost is £4385. System 2/64 has mini–disk drives and 64K and costs a mere £3050. Comart have also moved to new premises but the postal address is still PO Box 2, St Neots. Cambs. Tel 0480–215005





TM990 TRAINER FROM TEXAS

A single board micro teaching aid has been announced by Texas Instruments. Called the TM990/189M it is designed for low–cost, hands–on experience for engineers and programmers. Based on the 9900 16 bit micro it has 1K onboard RAM and 4K of ROM. Mass storage is provided by a cassette interface. Input is via a 45 key alpha–numeric pad and output is from a 10 digit display, any 10 bits from 32 may be viewed. The cost is £256 for 1–9 off. Also available now is a design manual for the 9900 series, at £8 it is aimed at all sections of the engineer field. Further information on both these products is available from Texas Instruments, Manton Lane, Bedford MK14 7PA.

FREE FLOPPY BOOK

A new book explaining the essentials about floppy disk systems has been published. Called "The Floppy Disk, What You Should Know" it is produced by Square One Co. The idea behind the book is to educate people in how to use and handle floppies. The book is free and available from Square One Co., 614 Eighteenth Avenue, Menlo Park, California, 94025.

BELL GETS THE BIRD!

We must apologise most profusely to two of our authors who submitted articles for the April issue. The Nascom Package was in fact written by Mr.M.Bell and not by Mr.R.Bird. Mr. Bird did in fact write the 16K RAM article.

ITHACA S100 AT NEWBEAR

Newbear are now stocking quantities of the Ithaca Audio S100 range. These include the following; 8K static RAM, a 2708 / 2716 EPROM card, a video display card, Z80 CPU, disk interface and a prototyping card. All are available as ready built and tested or as naked boards. Contact Newbear on 0635–49223.

NEWS

MICRO HIRE

If you want to try out your ideal system bef—ore actually parting with the hard—earned cash Microdigital Hire may be your answer. The range of machines available is quite large and includes the PET at £35 per week, NAS—COM at £14,Sorcerer at £50,Apple II at £70. The service will be on a personal basis if you are within driving distance of the shop or by Securicor.Potential customers should ring Mike Maughan on 051—227—2535. A full technical and software backup service will be available.

RAIR GOES TO COLLEGE

Thurrock Technical College is using the Black Box on Computer Science courses to develope and de-bug COBOL programs before running on the Essex county mainframe.This increases throughput on the main—frame as programming errors are reduced.Kitsen College of Leeds are also using a Black Box for A levels to run BASIC,COBOL and FORTRAN programs. They are also hoping to use it as an administrative tool and a student data base. Several other colleges are using the Black Box includ—ing Sterling University and Hastings College of Further Education,and a total of 50 machines are now installed in educational establishments.For further information ring Mark Potts on 01-836-4663.

Also announced from RAIR is the H1410 VDU. Produced by Hazeltine it is an upgrade of the model 1400. It produces the 64 character ASCII subset in 5x7 dot matrix form on a 12" screen All 128 ASCII characters may be accessed from the keyboard. Connection is via an RS232 at selectable Baud rates up to 9600 Price is £590 or £37 per month rental. Further information from Howard Sayles on 01-836-4663.

The twin mini floppy disc system provides off line storage of programs and data accessible more than 100 times faster than tape storage. Each $5\frac{1}{4}$" DISKETTE can store up to 81,920 bytes of program or data. Random average seek time may well be as low as 370 microseconds.

The twin drives and controller are housed in a metal saddle maintaining an integrated configuration, one of the major features of the PET. Connection is via the PET memory expansion port and the system comes complete with a PROM which boots the disc resident P-DOS into RAM. Control of the disc system is via PET BASIC USR instruction with simple commands from either the keyboard or under program control.

IBM 3740 compatible disc system.

The following disc system commands are available LOAD, SAVE, CREATE, DELETE and CATALOGUE. The file management system provides for up to 8 files to be opened concurrently. Files can be opened in READ, WRITE, UPDATE and APPEND mode. The user may write his own disc system modules to expand the facilities of the disc resident system.

£950.00 excluding VAT.

CLUB NEWS

Several new clubs have emerged from the mailbag over the last month and include the following.
Mr Michael Dean is starting up a TRS–80 users club in the Essex area and would like anyone interested to contact him. His address is 22 Roughtons, Galleywood, Chelmsford.

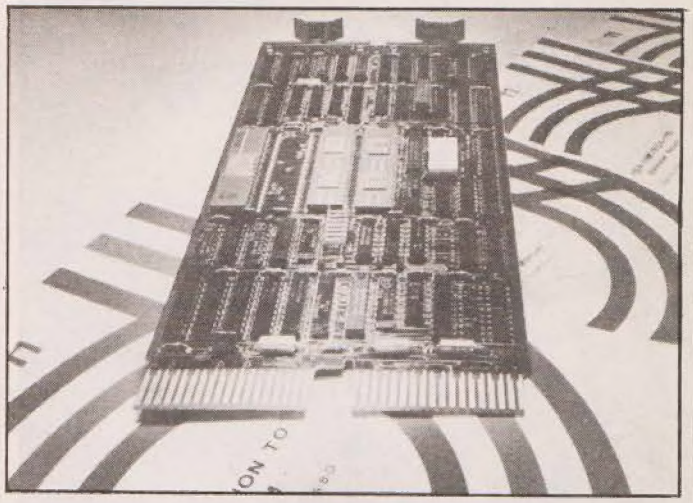
The National Association of 6502 Users is growing and currently has 33 members. New members are welcome and should contact the secretary, Mr W R Wallenborn at 21 Argyll Ave. Luton, Beds LU3 1EG.

An independant NASCOM users club (INUC) has been formed to promote the machine. Membership is £5 p.a. and you will receive at least 6 newsletters. One of the nice features is the software service, they will market members programs and ensure that the programmer gets a royalty for each sale. They may be contacted at Reliance Buildings, Damside Street, Lancaster.

If you live in the Bournemouth/Poole area of Dorset and are interested in joining a micro–club please contact Mr Ian Preece who is trying to start one up in that area. The address to write to is 246 Stewart Road, Charminster, Bournemouth.

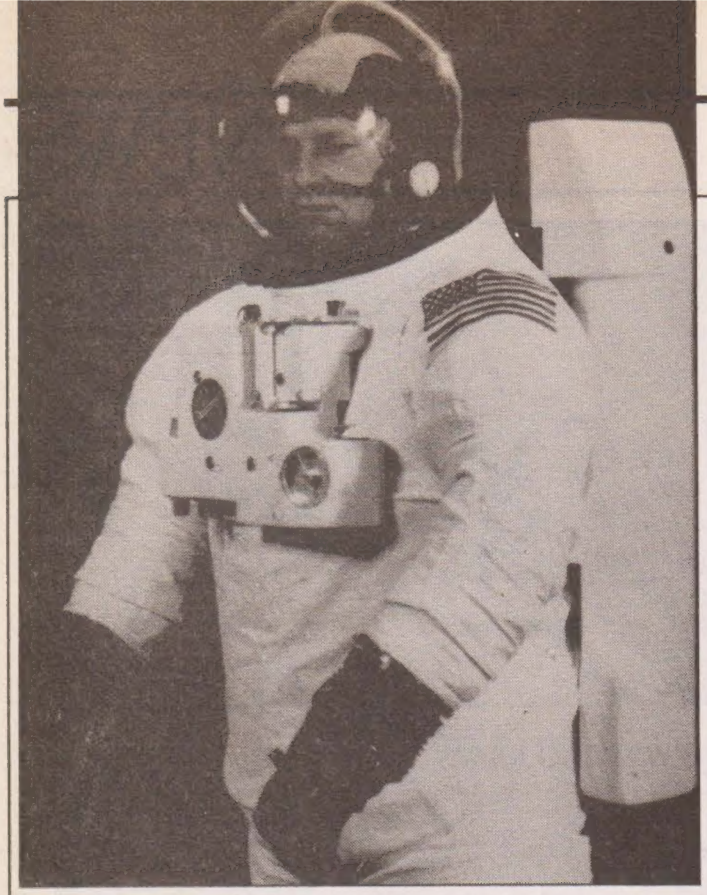
Finally on the club scene we have heard about the formation of the Grampian Amateur Computer Society. Membership is currently 16 and they meet on the second Monday of each month. For further information contact the President, Michael Brown, at 282 Queens Road, Aberdeen AB1 8DR.

As a postscript we received a news item from the Keswick Chess Club about their match against the PET Microchess 2.0 program. They won 5–1 ! The fastest winner was Robin Bumstead in 13 minutes. His only recorded comment was that he would like to have one at home to play with.



NEW MICRO FROM DIGITAL

Digital Equipment have launched a new LSI–11 family cpu. Designated the LSI–11/23 it is fully compatible with the existing LSI series bus and emulates the PDP–11/34 mini-computer. The new micro features the full instruction set of the 11/34 and can run RSX-11M and RSX-11S which are multi-tasking, multi–user operating systems.Software supplied is the standard range of languages for the LSI–11 family. The unit can address 256K byte of memory by using a memory management unit similar to that of the 11/34. The cpu is a direct plug in replacement for the LSI–11/2 and will provide an instant upgrade for users of this system. It will be available as a boxed unit with power supplies or as an OEM assembly. Digital may be contacted on 0734–583555.



HARRIS IN SPACE

The Space Shuttle program is to use the Harris 6100 12bit CMOS micro as a replacement for the clumsy umbilical cord. The cpu will give constant monitoring of the space suit conditions and display the data on a chest panel for the astronaut to observe. As an added bonus the micro will provide a navigation system and propulsion control for the free flight situation. Must say though that the guy in the suit doesn't look too happy with the idea at all!

CONFERENCE NEWS

The European Conference on Applied Information Technology will be held at Wembly Conference Centre between the 25th and 28th September. The BCS will be co-ordinating the event and you should ring 0895-31118 for more details....

The dates for INFO 80, that's the third International Business Computing, Word Processing and Information Management Exhibition and Conference to those who want it spelt out, have been settled. It will be held in the Cunard International Hotel from the 12th to 15th of Feb. 1980. The organisers, BED Exhibitions Ltd., may be reached at :- Bridge House, Restmoor Way, Wallington, Surrey.

PROGRAM ERROR

One tiny error crept into the NASCOM package last month, but it does tend to have rather nasty effects on your data. The error is in line 0F6D where the code 13 should be replaced by the code 1E. Several people seem to have problems loading, if this happens to you please WRITE in and we will forward the problems to the author.

GO TO WORK ON A CPU

The Greater Manchester Transport Executive are shortly to install a DEC PDP-11/70 processor and peripheral hardware to improve the bus services throughout the county. Manchester will be the second UK user of TRAX' DEC'S transaction processing software,' and this is expected to cut design costs by at least 30%. The processor will be located in the executives HQ in the centre of Manchester and will be connected to all 19 depots by DEC VT62 terminals. The first application of the system will be to implement their database management system called TOPIC (Traffic Operations Information Capture). This will enable up to the minute scheduling of buses once a main time table has been agreed on. The Principal program to run on the data from TOPIC will be a version of The Leeds University VAMPIRE and is hoped to make substantial cost savings without affecting scheduling. The mainframe at GMT is an IBM 360/70 and the PDP-11/70 will act as a front end.

DATACORDER FOR THE UK

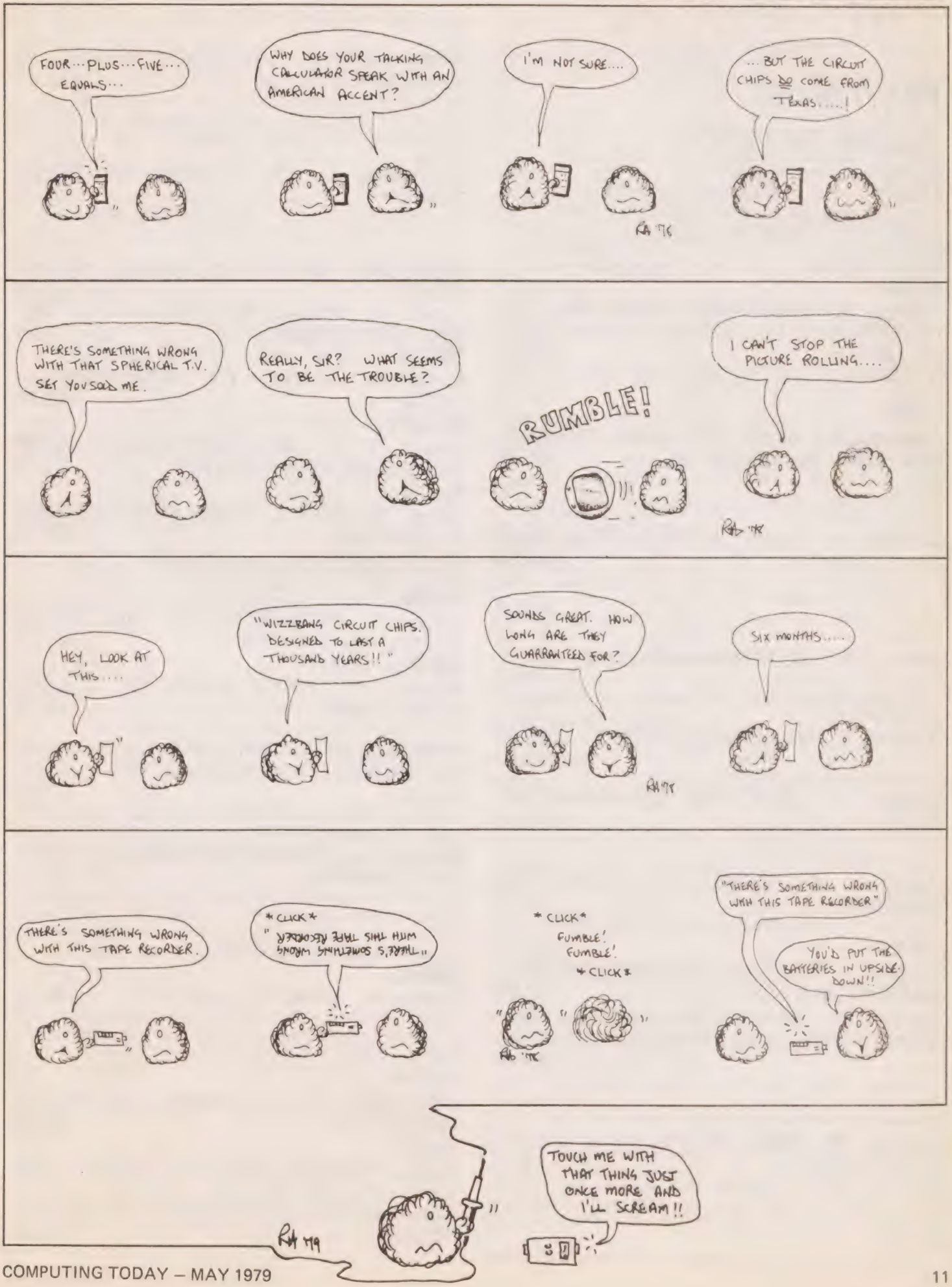
An American designed low-cost data capture unit is now being marketed in the UK by Office Services Swindon. The unit is designed as a stand-alone device and costs between £2000 and £3000 depending on quantity. Based on a Z80 cpu the unit incorporates an 80 character printer, an ECMA/ANSI cassette recorder, a 40 character display, full keyboard and an acoustic modem. The 16K memory can be expanded to 64K and to enable communication with the outside world it has an RS232 interface. Programming the device is by a language called Quick which is what it says it is! It can be used for most conventional data input and for form generation e.g. invoices, orders etc.. The machine will also support extended BASIC for stand-alone processing. Office Services can be found at 78 wimpole Street, London W1.

DATA TERMINAL

New from Micronics, the Micros people, is the Microlink V820 portable data terminal. The unit is based on the Z80 cpu and has a built in keyboard and acoustic modem. There is also a 40 column printer with an optional TV interface. Designed for use on the road by salesmen and engineers the basic unit will cost £1600. Mass storage is by cassette and a variety of firmware options will be available soon, including BASIC and a text processor, both in ROM. The whole unit is built into an executive style case. Contact Micronics on 01-892-7044.

Mr.R.Hill

BEASTIES



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Shows you how to read, write and understand basic programming language used in the new personal size microcomputers.

Albrecht B. BASIC. A self teaching guide (2nd edition) £4.50
Teach yourself the programming language BASIC. You will learn how to use the computer as a tool in home or office and you will need no special maths or science background.

Alcock, D. ILLUSTRATING BASIC £2.60
This book presents a popular and widely available language called BASIC, and explains how to write simple programs.

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Discusses these smaller computers and shows how they can be used in a variety of practical and recreational tasks in the home or business.

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This book explains assembly language programming of microcomputers based on the Intel 8080, Motorola MC6800 and MOS Technology MCS6502 microprocessor.

Barna, A. INTRODUCTION TO MICROCOMPUTERS AND MICROPROCESSORS £7.50
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This introduction to the 'computer-on-a-chip' provides a clear explanation of the important new device.

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Includes complete description of the processor. Support circuits, Architecture, Software, etc.

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This is an invaluable book for those who want to know more about hobby and personal computing.

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Korn, G. A. MICROPROCESSOR AND SMALL DIGITAL COMPUTER SYSTEMS FOR ENGINEERS AND SCIENTISTS £19.00

This book covers the types, languages, design software and applications of microprocessors.

Rao, G. U. MICROPROCESSOR AND MICROPROCESSOR SYSTEMS £20.50

A completely up-to-date report on the state-of-the-art of microprocessors and microcomputers written by one of the leading experts.

Rony, P. H. THE 8080A BUGBOOK: Microcomputer Interfacing & Programming £8.15

The principles, concepts and applications of an 8-bit microcomputer based on the 8080 microprocessor IU chip. The emphasis is on a computer as a controller.

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Creative techniques for beginning programmers.

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Mr. T. Turnbull – Petsoft Consultant

If you own a PET and want a disk now, read on...

One of the most vital requisites for any small business computer system is mass storage. It is an unfortunate fact that although a cassette based system will be more efficient in terms of data handling than it's manual counterpart it can actually be slower in terms of data retrieval. Searching through files on cassette for specific records is a very time consuming business and unless the software is written to allow the processor to perform other tasks during this period the wastage of actual computing time is high. With a disk based system this waiting time is greatly reduced, and the use of disks for large database handling is of great importance. It should be noted that commercial digital tape mechanisms, as opposed to the audio type, tend to be much faster and are still used in large computer installations as back-up storage to the on-line disks.

A Disk, A Disk, My Computer For. . .

The PET has had large amounts of software written for it and up till now this has been cassette based owing to the lack of a suitable disk. Commodore have promised a dual disk drive for the PET in May but there is a currently available alternative. The Compu/Think dual floppy drive has generated considerable interest in both the home and small business markets and we decided to take a look at it and give our comments about it.

Before we had actually got around to this task we heard from Petsoft that they were also interested in the device. We were offered the evaluation prepared for them by one of their technical consultants and the following report is based on that document.

System Overview

The disk operating system goes under the trade name of DISKMON and uses the well tried PERTEC disk drives. This gives the system good reliability and long life.

The main drawback of this system is that you need the EXPANDAPET memory board before you can fit it to your PET (MINIMUM 16K), the best board to buy is the 32K board as the disk system needs 4K of RAM to operate and with a 32K board the top 8K that is not used by BASIC can be used to store the machine code program for the disk without interfering with the storage of BASIC programs and thus allows full use of the 32K that can be accessed by the PET.

The memory board only takes around 20 minutes to fit and the ROM card for the disk just plugs into one of the slots on the memory board, another of the 4 slots on the board is used to plug in the disk unit connector, leaving 2 spare slots for future expansion. One of these slots can be used later to upgrade the disk system to double density. In its present form each disk holds 100K and if double density option is fitted this would allow 400K on line. The standard unit as it comes has 200K on line.

Command Set

The ROM card gives PET BASIC 9 additional commands that can be used in the "READY" mode.

$FORMAT #

The D stands for the number 1 or 2 depending on which drive you are using. This command formats an unused disk into 40 separate tracks, of these 39 are usable as number 1 is used for the disk directory. All disks must be formatted before use.

$MEM, AAAA

This command dumps a page of memory to PET's screen in hexadecimal and character format. The starting address must be a 4 digit hexadecimal number and the basic interpreter can be examined. The use of the graphics while displaying the memory dump to screen allows you to see where all keywords and error messages are stored.

$GO

This command executes a machine language program which has just been loaded into the PET using the $LOAD command. After loading a machine language program from disk the PET pointers are set to obey the $GO instruction and run a machine code program from the beginning, this saves working out the SYS address.

$DIR # D

This command lists the programs that are on a specified disk (1 or 2) and tells you the number of free tracks left available to the user.

$LOAD # D, $SAVE # D

These 2 commands load or save a program from a specified disk.

$LOAD # D,FILENAME

This command would load a BASIC program from drive D

$LOAD # D,FILENAME.GO

The suffix .GO tells you it is a machine code program that has been loaded.

$SAVE # D,FILENAME

This is used the same way as load command, with one

COMPU/THINK DISK REVIEW

A view of a typical small business, or advanced home computer, system. The PET has had the expansion memory fitted to hold the operating system. The printer is connected to the PET via an adaptor, IEEE-488 to RS232, for system output.

exception, if saving a machine code program you can if you want specify the range and starting point of the program.

$SAVE # D,WARTREK.GO,033A,04FF
This would save a machine code program that starts at address 033A and ends at 04FF. There is no need to specify these parameters when loading it back into PET as this is automatically taken care of.

$ERASE # D,FILENAME
This command erases a program from disk and reorganises free space so all free space is available for use and so the full disk can be used.
An example of this could be if you erased a 2K program then saved a 10K program. The 10K program would go to the same place as the 2K was erased from and the other programs on the disk in front of it would all move to make way for the larger program. This saves a lot of time when wondering how a program is going to fit onto a disk

$HALT OR $H
This command clears PET's program memory completely.

$BLIST,FILENAME
This command lists the name program to a printer and prints the filename at the top of the listing and numbers the pages every 50 lines as this command assumes that there are to be 50 lines to a page.

Additional Commands
There are another seven commands that can be used in READY mode or in PROGRAM mode, these are:—

$ODISK,R,D
This command opens a read file on a specified disk

$ODISK,W,D
Same command as above but opens to write a file.

$CDISK
This closes the currently used disk drive

$RDISK
This command reads the next sequential piece of data from a disk file and stores it in the variable DR$ where it can be transferred to some other variable in your program.

$WDISK
This command writes the contents of variable DR$ on to a disk data file where it can be read back later using $RDISK. The last piece of data stored should be the string "EOF" so an end of file can be tested for.

$XEQ # D
This causes the program whose name is in the special variable DF$ to be loaded and run. All variables are set to zero.

The Compu/Think disk showing the twin, vertically mounted drives. The lights on the front are to indicate 'drive on'.

$XER # D
As above but all variables are left intact so large programs can be overlayed.

$PRNT
This command causes the contents of special variable PL$ to be printed on a printer, if no printer is attached the command is ignored. This stops a program from stopping dead with a "DEVICE NOT PRESENT ERROR".

Using The System
When first switching on your PET you must give the command SYS(11*4096) to initialize the disk system This command only has to be given once and the disk system is initialized till switch off.
The only real care needed is you must make sure you insert a disk correctly or the write protect heads will not be disengaged and an error message will result and the disk will keep spinning until the $CDISK or $DIR # D. Instruction is then given to stop the drive. When loading a program the time taken is only a few seconds for a 7K program as opposed to over 2 minutes for the cassette. DATA is written and read back at the same speed as program loading so with this disk system you can have true computer file systems that are nearly on parr with a mini-computer.
When double density is available the speed of the disk system is doubled. There is a special command for security, this is POKE6,100. This command only allows RUN, __GO, $HALT.
This stops programs being listed, printed out or altered by a user. All READY commands except the ones mentioned are ignored. The disk system and cassette can only be used under program control and not from Ready mode so no—one can steal a copy of your program or disrupt your disk stored programs. The only way to get out of this mode is to type $HALT and the PET is reset and the program is cleaned from memory so that not even after this command can your program be looked at. This is a very useful command for stopping persons pinching your ideas and it allows an inexperienced user to run your program without damaging it.

Special Commands
The disk system has 4 reserved variables these are:-

DF$
This variable holds the file name or program name and must be initialized before the command $ODISK,W,D, is given or an error will result.

DI$
This variable stores the directory information (INDEX INFORMATION STORED IN THE DISK DIRECTORY) and is 8 bytes long.

DR$
This variable is used to transfer information to and from disk files.

PL$
This variable stores information for use by a printer.

Program Examples
Here is an example of how a DISK file differs from the PET cassette file:

PET CASSETTE FILE (READING FILE)

```
10 OPEN 1,1,0,F$
20 FOR X = 1 TO 200
```

```
30 INPUT # 1,F(X):IF ST  0 THEN 100
40 NEXT X
100 CLOSE 1
```

The above is very slow and is prone to error if the "EOF" or "EOT" is missed.

DISKMON VERSION OF SAME PROGRAM

```
5 DF$ = F$
10 $ODISK,R,1:FOR X = 1 TO 200
20 $RDISK:F(X)   #   VAL(DR$): IF DR$ = "EOF"
     THEN 100 (OPTIONAL)
30 NEXT X
100 $CDISK
```

This is a vastly faster program.

PET CASSETTE FILE (WRITING FILES)

```
10 POKE 243,122:POKE 244, 2:OPEN 1,1,1,F$
20 FOR X = 1 to 200
30 PRINT   #   1,F(X)
40 NEXT X
50 CLOSE 1
```

This is slow and prone to error

DISKMON VERSION OF SAME PROGRAM

```
5 DF$ = F$
10 $ODISK,W,1:FOR X = 1 TO 200
20 DR$   #   STR$ (F(X) ):$WDISK
30 NEXT X
40 DR$ = "EOF" : $WDISK
50 $CDISK
```

This program is extremely fast and reliable.

Utility Programs

Three programs are supplied with the disk, these are very useful and are as follows.

DISKCOPY	This program allows full disk copying and is very convenient for making security copies.
FILECOPY	This program allows the transfer and updating of data files from cassette to cassette or disk to disk or even disk to cassette and/or cassette to disk.
DISK-TESTER	This program fully tests the reading and writing of data on both disks.

The sloping board with the vertically aligned daughter boards is the ExpandaPET memory which is essential for the operation of the disk system.

From the evalvation and a caretul study of the documentation supplied it appears that this system will be a serious competitor to the Commodore disk drive when it finally appears. The documentation is both clear and concise for the Compu/Think drives and the Expanda PET memory and makes a welcome change from some that has passed through our hands. Using the disks should prove to be no problem once the operating system has been mastered and the documentation is clear on this important aspect.

Software Soon

Petsoft are currently considering putting their software on to Compu/Think format disks at a small increase in price, solely because a disk costs more than a cassette, and this may well prompt a reaction from other software houses in his field.

It will be most interesting to compare this system with Commodore's own and hopefully we shall be able to do this soon.

Our thanks are due to Petsoft for allowing us to use Mr. Turnbull's report and to H.B. Computers of Kettering for the photographs.

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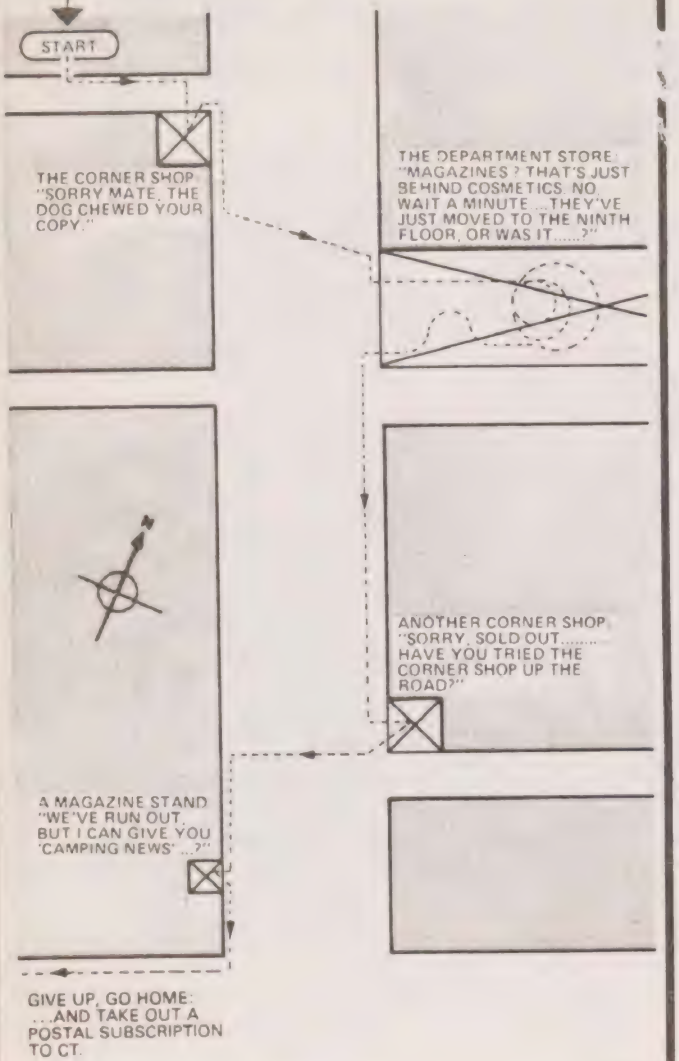

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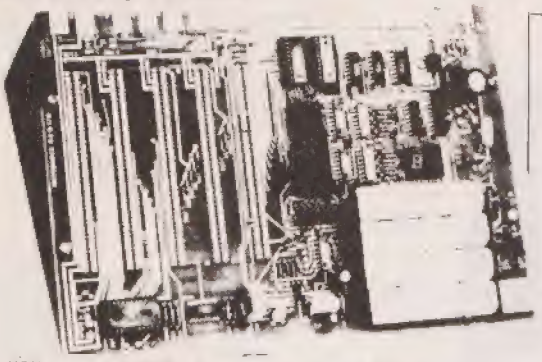

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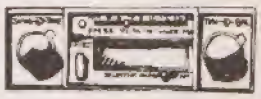

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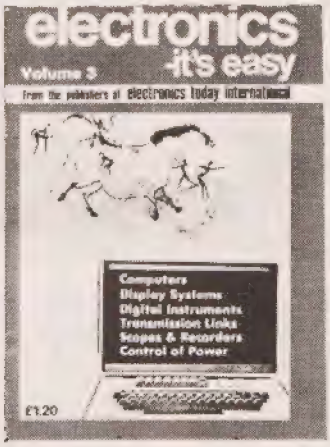

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Mr. P. Minch B.A.,

Offset problems with a circular solution

If you own a micro that is programmed in hexadecimal but do not have access to an assembler then you have to calculate offsets by hand. Not many people know their hex addition tables by heart (for example A + B = 5 carry 1), so they use look up tables. The circular slide rule described in this article is much quicker to use.

Making the Rule

Cut out two circular discs of stiff card 10 cms. and 14 cms. in diameter. Divide each scale into 16 equal segments and mark the divisions as shown in Fig. 1, writing the appropriate numbers into each segment. Both scales have the hex digits 0 to F on them as their main inscription. They both also have the decimal equivalent of A to F where the scales meet as a reminder of the hex times 1 table. The outer edge of the outer scale has the 16 times table on it. The inner edge of the inner scale has the 15's complement on it marked as 0, 1, etc.

How to Use a Slide Rule

Now that the only useful scale on a normal slide rule is the one on the edge for drawing straight lines it might be worth reminding the very young or forgetful of us what a slide rule did. As the scales are rotated and the inscribed numbers counted off the distances, or angles in our case, are added or subtracted depending on the direction. Originally the scales were marked logarithmically so the effect was to multiply or divide the numbers, but our scales are linear to give addition and subtraction.

Now For How To Do It

TO ADD e.g. X + Y = ANSWER

Rotate the inner scale until its zero is under 1 on the outer scale. Clamp the scales together with your fingers and trace round **clockwise** until you find Y on the inner scale. The ANSWER is above it on the outer scale. If you pass the outer heavy black line carry 1 to the next column.

TO SUBTRACT e.g. X – Y = ANSWER

Find X on the outer scale. Rotate the inner scale until Y on it is under X. Clamp and trace round **anticlockwise** to zero on the inner scale. The ANSWER appears above it on the outer scale. If you pass the outer heavy black line pay back one to the next column.

Fig. 1. The two scales must be fastened together with a small nut and bolt through the centre.

Practice adding and subtracting with low decimal numbers so that you can easily check the result. Now check through the following examples with your slide rule. They are based on 8 bit bytes and assume 2's complement arithmetic, that is, if the most significant bit is a 1 the number is negative.

Addition

2 D
3 E+
6 B

D + E = B carry 1. The slide rule in Fig. 1 is shown set

for this addition. Remember to add clockwise or you will lose the carry 1. 2 + 3 + 1 = 6 you can do in your head of course.

Subtraction

```
  7 3
  5 6—
  1 D
```

3 — 6 = D pay back 1. Fig. 1 shows the slide rule set for this calculation also. The pay back 1 makes the 5 into 6 giving 7 — 6 = 1.

Decimal to Hex Conversion

This is achieved by successive division by 16, the hexadecimal remainders forming the result. It is hear that you need the 16 times table on the outer ring of the rule. The following example shows the conversion of a double byte (double precision) number, $10{,}815_{10}$ to $2A3F_{16}$.

```
16) 10815
16)   675 r F
16)    42 r 3
16(     2 r A          2 A 3 F 16
          0 r 2
```

A common mistake is to forget the last line, that is, 16 into 2 goes nought remainder two.

Fig 2. The rule is shown set to add D + E as in the addition example.

Hex to Decimal Conversion

For single byte numbers use the 16 times and 1 times tables on the rule to look up the value of each nibble and add them together. For example,

$$\begin{aligned} 3b_{16} &= (3 \times 16) + (B \times 1) \\ &= 48 + 11 \\ &= 59_{10} \end{aligned}$$

For multiple byte numbers you really need a calculator to handle the decimal arithmetic. If your calculator is the sort where the next operator (+ X) completes the previous operation the result is most easily obtained by "expanding the polynomial" without using brackets, for example,

$$\begin{aligned} 6BE4_{16} &= 6 \times 16 + 11 \times 16 + 14 \times 16 + 4 \\ &= 27620_{10} \end{aligned}$$

Negative Thinking

If a single byte number is used as a counter the largest number it can hold is 255_{10} that is FF_{16}. However when the same single byte is used in a two's complement arithmetic calculation the number will be considered as negative if the leading bit is a 1. That is, all single byte Hex codes "higher" than 7F are negative numbers. To find what such a number represents in decimal it must first be negated, thus forming its positive hex version, and then converted to decimal in the normal way.

Negating Hex Numbers

To negate a number write down its 15's complement and add 1. The complements of the hex numbers are given as 0 etc. on the inner scale of the rule. Here the example in hex and binary for comparison.

```
negative number   = C5  = 11000101
complement        = 3A  = 00111010
add 1             = 3B  = 00111011
decimal value     = 59  = 59
```

So $C5_{16}$ represents -59_{10} in 2's complement form.

Similary to load an address with a negative number simply repeat the above procedure, for example.

```
negative decimal number  = —12
positive hex version     =  0C
complement               =  F3
add 1                    =  F4
```

So $F4_{16}$ represents -12_{10}.

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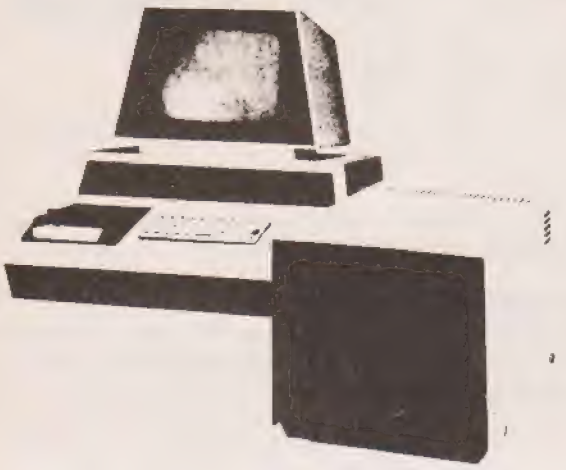

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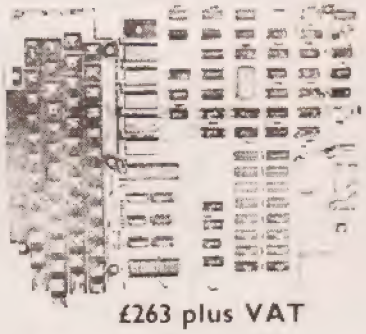

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We review a new Teletext decoding home computer

At last a British firm is exploiting a British lead in the information industry. The Liverpool based firm of Technalogics have developed what is believed to be the first home computer system which is directly interfaced to the Teletext system. The computer is based on the well proven Motorola 6800 CPU and provides a self contained Teletext decoding system, a home computer and the capability of being expanded into a small business system.

What Goes On

The concept behind the development of the system was to exploit the use of Teletext as an information source and to allow connection of a micro-processor system to this source to enable use to be made of avaivable data. As well as providing an extremely high quality Teletext display the system has a resident 3K mini-BASIC to allow user programs to be run on the machine. A monitor is available for machine code programming. As an added bonus the Post Office are to evaluate TECS for connection to Prestel; this will give access to a vast database (see Prestel article) and allow for user creation of pages on the system.

How It Does It

All the decoding of the Teletext information is performed in software, this allows the machine to store data offline for later use. The data is transmitted in the top two lines of the TV picture as serially coded information. The database is scanned and two rows of data are sent every 20 mS. Each page is made up from 24 such rows. Because the data is sent in this way there is a finite delay between the page number being entered and the actual page being received. The TECS system reads the top two lines of the TV display into a small buffer, 256 bytes, and then checks to see if the data trapped is from the page that was requested. If it is, this data is decoded by the resident program and the resulting information placed in a 1K RAM for display on the screen. The decoding process is performed during the 20 mS that it takes for the next rows to be transmitted. The data held in the 1K RAM is formatted into a single screenful of information arranged in a 40 column by 24 row format. Because the character generator and display RAM are common to both Teletext and BASIC you can use the full character set under BASIC, thus creating your own Teletext style pages. This would enable you to have an in-house system. Because the decoding is done in software it is possible to write programs to either store the Teletext data offline, output to a printer or use the data as actual data for a program. Telesoftware is currently being tried by the IBA. Thus for instance a program could be written to monitor the changing stock exchange prices over a given period of the day and then produce a graph of specific changes. Because the programs have access to the full character and graphics set used in Teletext programs like this will present little problem, educational quizzes using conceal-reveal, coloured bar graphs and many other possibilities are made easy.

The Languages

The machine code monitor performs all the usual functions such as load, dump, memory modify etc., and also has pre-settable breakpoints. The monitor, if not resident in PROM, can be loaded under BASIC to allow machine code sub-routines to be written. The mini-BASIC is an integer BASIC with 26 variable names, 1 and 2 dimensional DIM statements, the usual maths expressions and GOSUB, RND, TAB, LET etc. A more advanced BASIC will be available soon in either cassette, ROM or disk form. TECS will also be able to run PASCAL which is under development.

The Central Processor Board

This as you may expect is the heart of the system. The bus is of a standard format, 16 true address lines and 8 inverse data lines, all are fully buffered. The processor can address the full 64K. As well as the CPU the card contains a bi-directional RS232 interface with strappable Baud rates for both send and receive between 75 and 9600. This allows for a low speed input and high speed output or vice-versa. The CPU clock chip (6875) provides all the necessary processor signals and also those required for external RAM. An 8 bit parallel port is also provided, this can be used for the keypad or a parallel-output keyboard. Memory provision on the board is 4K of ROM,

2716, containing either Teletext, Monitor and Prestel software or Teletext and a 3K mini-BASIC. There is also 4K of RAM, 2114, for user programs. Further features of the card include a hardware parity check for hamming error correction, 16 levels of hardware interrupt and a real time clock interrupt.

The Teletext Input Board

The card takes the analogue input from the TV and shapes to TTL levels, the data is then stored in a 256 byte RAM. This RAM can also act as the PO security check for Prestel connection, battery back-up is available for this. As well as performing these functions it can act as the processor memory if no RAM is available on the CPU card. The RAM also acts as the hardware stack. Also contained on this card is a 1K RAM for the display, with buffered read and write it provides a memory mapped VDU, with byte O being the top left hand corner so any position on the screen can be found using the formula 40 times the row address + the column offset.

The Display Board

This card provides the Teletext output into the RGB stages of a TV or indeed a monitor. The card houses an X887 character generator ROM plus all the new Teletext facilities. These include conceal-reveal, double height, flashing characters and background colour, the transparent cursor, allowing you to see what you've just done!

The Basic System

With the three boards detailed above you have a system which can decode the Teletext signals, run BASIC programs, run machine code programs and in the not too distant future communicate with Prestel. The output will drive a colour monitor or a modified TV. If you want to avoid the modification of a TV, an aerial input board is available, complete with tuner assembly, and this will enable you to remotely change between TV, Teletext and Prestel displays. Prestel connection, subject to PO approval, will only be used with this aerial input module as type approval for each TV connected would have to be sought for direct drive.

As with all systems that really interest the buyer the most important question is that of expansion. The plans for the TECS are well advanced, the Prestel connection is merely awaiting PO approval, and include the following. With the availability of 2102's RAM extension will be possible up to the full 64K. The projected card will handle 32K of dynamic RAM and 16K of either PROM or RAM, with a 16K RAM for the DOS to allow greater flexibility. Also under development is a general purpose interface board. This will handle up to 4 disks, either standard or mini-floppies, an RS232 bi-directional interface as on the processor card, two Kansas City bi-directional cassette interfaces operating at 300 Baud and 2 8 bit parallel ports. In addition to all this there will be a 256 byte ROM for the DOS bootstrap and a software controlled bleeper for general useage. The DOS will be crystal controlled but the RS232 will run off the system clock as on the CPU card.

A simple Kansas City interface is available to hang on the bus for immediate use. The tuner encorder card actually consists of a main card with a sub chassis. This provides full TV tuner and i.f. with sound and full remote control.

From left to right: The TECS running a basic program. The console is the desktop version with the full keyboard and ancillary controls. The disk drives will mount on top of the unit, giving twin mini–floppies with 160K total storage.
The centre photo shows left to right the display board, the CPU and the Teletext decoder board.
The right hand photo shows TECS working as a Teletext decoder. The display is in full colour with all the latest facilities.

The system allows full broadcast lock and this enables the Teletext inserts to appear in PAL full colour which is not normally possible. The modulator uses an 8MHz bandwidth for high quality.
The disks for the system will be BASF drives using single sided floppies and having a storage capacity of 80K. These will have a seperate PSU to prevent interference problems.

Hardware Configurations
Two versions will be available, a desktop system with a full keyboard for Prestel Editing or a short form keyboard for TV control and programming, and a rack based system for OEM and hobbyist useage. The cased version will have either 2 integral floppies or an add-on unit containing four. The basic cards supplied with the cased version will be the CPU, Teletext decoder and the display card. The unit will have expansion slots and also room for the aerial input board and modem. A power supply will also be included in the unit.
The rack mounted version is based in a 19" 5U rack and can be supplied with the full range of cards as for the cased version. The power supply will be a separate unit. Expansion room for disks is available within the rack or as a separate unit.

Background
The system was developed from a hardware Teletext decoder also produced by Technalogics. All the development has been done in house by the three directors of the company. The quality of the circuit boards and the metalwork is very impressive and because all the logic design possible has been done using low power IC's the unit should give a long trouble-free life. All the units sold are being registered to enable easy maintenance and also to provide a user club. The various cards for expansion will be available shortly, orders can be placed for the actual system now and will be dealt with in strict rotation. The three main cards will also be available as kits for the dedicated home constructor. The CPU board will also be available on its own for those of you who like to configure your own system.
After spending a day talking to the designers and playing with the various facilities the overiding impression was that this could be a very big step forward in the home computer market and the provisional prices indicate that you won't have to give the traditional arm or leg to get one in your living room. One can only hope that now the lead has been taken in the information field by British companies that the progress is maintained to the same high standard as this machine.

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What to look for in the JUNE ISSUE on sale May 18th

Electronic Games Survey

Whether you want to play draughts, break codes or learn maths there is a little box somewhere that would like to hear from you.
Next month we shall take a look at a selection of the little beauties that have appeared, both from the UK and America.
The variety available is almost bewildering as you will see and although some will hold few surprises there are one or two that are really excellent.
So make a date with next month's Computing Today if you enjoy a break from the more serious side of computing.

Random is Yourself

One of the requisites for many games programs is a random number generator. For those of you who do not have access to a high level language this Hardlines project will give you a random number machine. We are also throwing in an example program to make this interesting to both software and hardware readers.

Humbug Monitor

A new, more powerful monitor for the TRITON, ETI's home computer, has been produced. We give you the low–down on its facilities in next month's issue.

Graded Gains Give Program Power

Apologies for the humour, but in this case it can be justified. One of the best methods of initiating yourself into the mystic arts of machine code programming is to grab hold of an evalvation kit and start key pushing.
Confusing though is it not?
The Motorola D2 is one of the best of its type, and next month we present an article based on this machine that is designed to take a reader step by step through an ascending series of program examples.

Nascom Package

Another excellent program for the NASCOM from Malcolm Bell. Next months piece is an educational package that uses a libray of "subjects" to cover virtually any field you wish.

Mr. M. Bell

Micro system–mini language

M5 is being offered by MICRODIGITAL as a high level language of 0.6K to run on a standard NASCOM 1 with a T2 monitor. At first glance the facilities offered are impressive for its size and the documentation is full of optimism. It must be accepted from the outset that if 2K and 4K BASIC interpreters have limitations then the 'M5' must have definite handicaps, but if it is successful in providing programming assistance for what is essentially a machine code micro–system then it fulfils its function and its limitations must be accepted.

Language Facilities

M5 is mainly intended for positive integer (ie whole number) arithmetic within the range 0 to 65,536. Its use of Reverse Polish Notation (RPN) in preference to arithmetic notation allys it with the early four function calculators, and indeed those still produced by Hewlett Packard. There are 26 possible register labelled A to Z for storing data and these can be entered, recalled or operated on at any time. Facilities have been provided to print 'strings', to input data from the keyboard and to output data onto the CRT.
One of the essentials of any high level language is its ability to make 'decisions', and here we have a choice of eight possibilities. It does however lack a 'Jump If Negative' instruction which would be very useful. The inclusion of a 'GOSUB' instruction would also be worth its sacrifice in RAM. All jumps are made to flags which can be any character available on the keyboard.
Once a user program has been entered it can be modified by using the 'EDIT' command which lists the program and positions a cursor. The cursor is in the form of a rub–out character positioned over the required entry. For reference the blotted out entry is printed at the top of the screen. Further commands will reposition, select next line or forward/back–ward space the cursor. Changes are then made by deletion or insertion commands.

The Hardware

The package was received containing one cassette tape and one read only floppy. The 'floppy' was dated 23rd March, 1979 and marked 'Provisional'. It is very well written and illustrated using functional programs. Each command and operator is well explained and a list bringing these together is shown in Table 1. A hexadecimal listing has been provided and this is correct in every detail. The cassette tape has three copies of the program in NASBUG T2 format, is of good quality and loaded first time.

The Program

The program is extremely well written and even an experienced programmer would benefit from analysing it. Briefly, and without giving the game away, the program uses three NASBUG routines, CHIN, SCROLL and CAT. These are in–cluded within the three main sections to facilitate input and output control. The first section, INPUT, simply enters the keyboard character into the user RAM and echoes the character on the CRT. The EDIT and RUN sections consist mai–nly of decision boxes leading to short action branches, to carry out each function. Extensive use is made of the stack when carrying out multiple arithmetic routines and this can encroach severly into the user RAM allocations which begin at location 0EFE.
As stated earlier there are bound to be disadvantages. The CRT is based on the 'write and scroll' techniques and this means that the top line of display cannot be used. Because of this the top line has been allocated for register storage and this results in a messy CRT appearance. What is more to the point however is that if 'shifted backspace' is ever used in a user program all the register contents will be destroyed.
When running a program errors are detected and displayed as shown in Table 2.

Operational Experience

The interpreter is accessed by keying 0C60 whereby a prom–pt 'M5' is displayed. The commands can then be entered as described. We found that it worked well, or almost. The cursor control during edit requires the use of the "<" and ">" keys which do not exist on a NASCOM with T2 monit–or, however changing locations 0E83 to 29H and 0E88 to 28H allowed the "(" and ")" brackets to be used instead. Another difficulty was encountered when trying to correct an entry during EDIT, INPUT facility. Not only does the erroneous character get entered but the backspace also. It must be remembered that although a backspace character appears to work on the CRT it does not function when the EDITOR is in use.
It is possible to make the user program area larger by includ–ing the 10H bytes of RAM thst are not usefully employed at the rear end of the program. These modifications to the orig-inal program are documented at the end of the article in Table 3.

Conclusions

A high level language can never be a bad thing for an inexper-ienced programmer, and this one works well, although most peoples needs would soon outgrow it. M5 is no real substit–ute for the sofhistication that can be obtained using machine code, nor can it compete against BASIC in larger systems. It does however have the advantage that it is small and can be used within a 1K RAM. The 230 odd bytes available to the user is very small but programs can be successfully written within this space. The "Lunar Lander" program detailed at the end of this article, Example 1., can be run on the stand–ard NASCOM provided that the program improvements in Table 3 are incorporated.
There is mention of an 'M6' interpreter, and if this is can enhance the M5 to include negative integers, GOSUB and Go If Neg and is perhaps packaged in a 1K ROM, the advantages of this language may become more apparent.

Value For Money ?

The M5 is being given away free by MICRODIGITAL if you purchase your NASCOM from them, if not it will cost you £10 for the complete package. It is the authors opinion that this is overpriced and the money could possibly be better spent on a T4 or B–BUG monitor. If a high level language is desired then one of the 2K BASIC/Monitor packages that are coming on the market might be a better investment.

Example 1.

LUNAR LANDER

Note:– The modifications in Table 3 must be carried out.

```
(W720=F520=H65=V
(X" HT="H=?" VEL="V=?" FUEL="F=?)ZS
" BURN="?=B,F)GY0=F=B
(YF,B–=FB,2*=N256=A(RN,A/,A)LT+,2/=A)UR(S"
"(TA,2/,V+=SH,S–=H)ZPV,A–,5+=V,999)LZ
H,999)LM)UX
(M" CRASHED! AT"V=?"FT/SEC")M
(P9,V)GM" GOOD LANDING")M
(Z" TAKEN OFF!!")M
```

Another note:– The program must be entered exactly as shown to avoid errors. Spaces are important!

Table 1.

This table lists the available features of M5.

Commands:– There are four that can be used.

I	INPUT	Enters a new program from the start of the user RAM. It will over-write any existing program. A new program is terminated by a semi-colon ' ; '.
L	LIST	This will list the current program onto the CRT.
R	RUN	Runs the program.
E	EDIT	A very useful command which allows the current program to be easily modified.

Editor commands:–

R =Reposition the cursor at the start.
N =Next line.
(=Backspace cursor.
) =Forward space cursor.
D =Delete character.
I =Insert the following character until ; .
W =Return to the command mode.

Decisions

U	Unconditional jump
Z	Jump if zero
N	Jump if not zero
E	Jump if x = y
X	Jump if x ≠ y
L	Jump if x ⩽ y
G	Jump if x > y
M	Jump to command mode

Mathematical Operators

+	Add
–	Subtract
*	Multiply
/	Divide
£	Decrement 'x'
&	Increment 'x'

Other Operators

" " String
n=? Print the contents of register 'n'
? Input from the keyboard

The NASCOM 1 which the M5 runs on in its standard form.

Table 2.

Error Messages:–

SYM	ERR x	The symbol x is not allowed except in a string.
ID	ERR x	The symbol x is not a valid identifier, and an attempt was made to copy a value to it. Eg = x occurred.
JID	ERR x	The label was not found when a jump occurred.
JC	ERR x	The symbol x occurred in a jump condition position and is not a valid code.
	ERR x	The symbol x caused an error that is not one of the above.

Table 3.

The author has suggested the following changes to the M5 interpreter to rectify errors, clean up the display and increase the available user RAM by 10H bytes (i.e. run from 0EEE).

Location	Old	New	
0E83	3E	29	") "
0E88	3C	28	" ("
0E56	1F	1E	Clear CRT on RUN
0E5A	FD	ED	These changes start the
0EDB	FD	ED	user RAM at 0EEE
0E2F	FD	ED	instead of at 0FEE
0DE1	FE	EE	
0EB3	FF	EF	

SOFTSPOT SPECIAL

These programs have been submitted by our readers and as such have not been tried or tested by us. It should be noted that several of the programs are specified to run on certain machines and therefore you will have to modify them to run on your own systems. We encourage the submission of programs for Softspot and pay for any that we publish. If you are considering sending a program in please document it carefully and try to include a flowchart. Programs should be sent to:—

Computing Today,
SOFTSPOT,
25–27 Oxford Street,
London W1R 1RF.

Happy programming!

Mr.M.BELL

RAM Test

The program runs on a NASCOM, although it should easily be adapted to run on any Z80, and writes 1 to FFH into each RAM location and then steps to the next. In the event of a failure the following is printed;
Location,Number written,Number read.

EXECUTE FROM 0C50

```
0C50   21 80 0C   LD HL=0C80     Test start locn
0C53   AF         XOR A          A=0
0C54   77         (HL) , A       (HL)=0
0C55   BE         CP (HL)        Read,test A
0C56   20 06      JRNZ +8        If not true go to
0C58   3D         DEC A          sub 'failure'
0C59   20 F9      JRNZ –5        Do again if A/ 0
0C5B   23         INC HL         Step to next loc
0C5C   18 F6      JR –8          Repeat
```

SUBROUTINE 'FAILURE'

```
0C5E   4F         LD C , A       Write to C
0C5F   7C         LD A , H       Print H
0C60   CD 44 02   CALL B2 Hex
0C63   7D         LD A , L       Print location
0C64   CD 44 02   CALL B2 Hex    Print L
0C67   CD 3C 02   CALL SPACE
0C6A   79         LD A , C       Print write No.
0C6B   CD 44 02   CALL B2 Hex
0C6E   CD 3C 02   CALL SPACE
0C71   7E         LD A , (HL)    Print read No.
0C72   CD 44 02   CALL B2 Hex
0C75   CD 40 02   CALL CRLF
0C78   7C FE 10   LD A , H CP=10
0C7B   20 DE      JRNZ –20H
0C7D   C3 86 02   CALL PARSE     Return to mon.
```

Note: A succesful test is indicated with location 1000 displayed.

Text Interpreter

This routine loads text from the keyboard directly into memory. The memory start location MUST be loaded into FA1 and FA2 each time the interpreter is returned to.
Special characters;

B/S	Backspace
@	End of string (stores 00)
Shifted B/S	Change case
$	Return to monitor

EXECUTE FROM FA0

```
FA0   21 xx xx              HL=?
FA3   CB 83       'RST'     RST E bit 0
FA5   CD 3E 00    'CHIN'    CALL 'CHIN'
FA8   FE 24                 CP=24H
FAA   CA 86 02              JZ PARSE
FAD   FE 1E                 CP=1E
FAF   20 08                 JRNZ 'WORD'
FB1   CB 43                 TEST E bit 0
FB3   20 EE                 JRNZ 'RST'
FB5   CB C3                 SET E bit 0
FB7   18 EC                 JP 'CHIN'
FB9   FE 40       'WORD'    CP=@
FBB   20 08                 JRNZ 'B/S'
FBD   36 00                 (HL) , 00
FBF   CD 40 02              CALL 'CRLF'
FC2   23                    INC HL
FC3   18 E0                 JR 'CHIN'
FC5   FE 1D       'B/S'     CP=1D
FC7   20 03                 JRNZ 'SPACE'
FC9   2B                    DEC HL
FCA   18 0C                 JR 'CRT'
FCC   FE 20       'SPACE'   CP=20H
FCE   28 06                 JRZ 'STORE'
FD0   CB 43                 TEST E bit 0
FD2   28 02                 JRZ 'STORE'
FD4   C6 20                 ADD 20H
FD6   77          'STORE'   (HL) , A
FD7   23                    INC HL
FD8   CD 3B 01    'CRT'     CALL 'CRT'
FDB   18 C8                 JR 'CHIN'
```

Mr.I.DAVIDSON

Crosshatch Generator

This produces four of the most common crosshatch patterns on a TV set and allows easy selection of each type. The actual adjustment of a TV is fairly easy once the convergence controls have been found and a full explanation of the methods was given in ETI September 1978. The program runs in 1K on TRITON.

```
1600   50     End address for taping
1601   16
1602   CF     Clear screen
1603   11     Load REG pair DE with string start address
1604   09
1605   16
1606   CD     Call PSTRING
1607   2B
```

```
1608  00
1609  50    P
160A  52    R
160B  45    E
160C  53    S
160D  53    S
160E  20    Space
160F  43    C
1610  2C    , (comma)
1611  44    D
1612  2C    , (comma)
1613  56    V
1614  20    Space
1615  4F    O
1616  52    R
1617  20    Space
1618  48    H
1619  04    EOT marker
161A  CD    Call INC H
161B  0B
161C  00
161D  01    Load REG pair BC with graphics for
161E  77    crosshatch
161F  73
1620  FE    Compare with code for C
1621  43
1622  CA    If C jump to screen routine
1623  40
1624  16
1625  01    If not change graphics to dots
1626  12    Dot
1627  20    Space
1628  FE    Compare with code for D
1629  44
162A  CA    If D jump to screen routine
162B  40
162C  16
162D  01    If not change graphics to verticals
162E  74
162F  20
1630  FE    Compare with code for V
1631  56
1632  CA    If V jump to screen routine
1633  40
1634  16
1635  01    If not change graphics to horizontals
1636  73
1637  73
1638  FE    Compare with code for H
1639  48
163A  CA    If H jump to screen routine
163B  40
163C  16
163D  C3    If none of the above jump back to the
163E  02    start and try again
163F  16
1640  2A    Set REG pair HL to the address of the
1641  00    first VDU location
1642  10
1643  70    Move REG B to VDU
1644  23    INC HL
1645  71    Move REG C to VDU
1646  23    INC HL
1647  7C    Copy REG H to ACC
1648  FE    Compare with one address past VDU
1649  14    (most significant byte only)
164A  C2    If not jump back to screen routine
164B  43
164C  16
164D  C3    If the screen is filled jump back to INC H
164E  1A
164F  16
1650  00    End address for taping
```

Etch–A–Sketch

This program emulates the children's toy of the same name. The first character or graphic key pressed will cause the sel–ected symbol to appear near the centre of the VDU screen. On pressing one of the keys U,D,L or R the symbol will move in the selected direction leaving a trail behind it. It should be noted that if the drawing moves off the screen you run the risk of corrupting the monitor. The program is for TRITON and runs in 1K.

```
1600  6B    End program address for taping
1601  16
1602  CF    Clear screen
1603  21    Set pointer to middle of VDU
1604  15
1605  12
1606  CD    Call INC H
1607  0B
1608  00
1609  47    Copy ACC to REG B
160A  70    Copy REG B to VDU
160B  CD    Call INC H
160C  0B
160D  00
160E  FE    Compare with code for R
160F  52
1610  CA    If R jump to subroutine to move right
1611  30
1612  16
1613  FE    Compare with code for L
1614  4C
1615  CA    If L jump to subroutine to move left
1616  40
1617  16
1618  FE    Compare with code for U
1619  55
161A  CA    If U jump to subroutine to move up
161B  50
161C  16
161D  FE    Compare with code for D
161E  44
161F  CA    If D jump to subroutine to move down
1620  60
1621  16
1622  C3    If none of the above jump back for new
1623  0B    input
```

```
1624    16
                    Movement subroutines
Move RIGHT
1630    23          Increment pointer
1631    C3          Jump to main program
1632    0A
1633    16
Move LEFT
1640    2B          Decrement pointer
1641    C3          Jump to main program
1642    0A
1643    16
Move UP
1650    97          Clear ACC
1651    2B          Decrement pointer
1652    3C          Increment ACC
1653    FE          Compare to 40(Hex)
1654    40
1655    C2          Loop until it matches
1656    51
1657    16
1658    C3          Jump to main program
1659    0A
165A    16
Move DOWN
1660    97          Clear ACC
1661    23          Increment pointer
1662    3C          Increment ACC
1663    FE          Compare with 40(Hex)
1664    40
1665    C2          Loop until it matches
1666    61
1667    16
1668    C3          Jump to main program
1669    0A
166A    16
```

Confuse–A–Cat

The program is a modified version of the one in the TRITON manual. It alternates between filling and emptying the screen with characters. It is written in tiny BASIC and will run in the standard kit memory.

```
10      VDU 0,12
20      LET I=0, J=0, K=1, L=1, N=0, T=0, Q=931
30      LET I=I+K, J=J+L, T=T+1
40      IF I>63 GOTO 60
50      IF I>=1 GOTO 70
60      LET K=–K, I=I+K+K
70      IF J>16 GOTO 90
80      IF J>=1 GOTO 100
90      LET L=–L, J=J+L+L
100     LET M=I+(J–1)*64
110     IF T<=Q VDU N,13
120     IF T>Q VDU N,32
130     VDU M,32
140     IF T>Q VDU M,13
150     LET N=M
160     IF T=2*Q–1 GOTO 10
170     GOTO 30
```

Mr.H.J.GARWOOD

Reversal Game

This program is a modified version of the 'Reversal' numbers game written by Don Scales. The original version appeared in the January Computing Today supplement. The program is written to run on a TRS 80 with Level II.

```
5       CLS
10      PRINT "THE REVERSAL GAME"
20      FOR I=1 TO 9
30      LET A=RND(9)
40      IF I=1 GOTO 80
50      FOR J=1 TO I–1
60      IF A(J)=A GOTO 30
70      NEXT J
80      LET A(I)=A
90      NEXT I
95      LET B=0
200     PRINT A(I);A(2);A(3);A(4);A(5);A(6);A(7);
        A(8);A(9)
210     INPUT "NUMBER TO REVERSE";J
220     IF J<1 GOTO 240
230     IF J<10 GOTO 260
240     PRINT "INVALID – TRY AGAIN"
250     GOTO 10
260     LET K=(J+1)/2
270     FOR I=1 TO K
280     LET A=A(I):A(I)=A(J+1–I):A(J+1–I)=A
290     NEXT I
295     LET B=B+1
300     FOR I=1 TO 9
310     IF A(I)<>I GOTO 200
320     NEXT I
330     PRINT "TOTAL",B
333     FOR X=1 TO 500
334     NEXT X
340     GOTO 5
```

Mr.N.R.GRAYSON

Mastermind Game

Another version of the popular game 'Moo', or 'Bulls and Cows'. This Version is written in Tiny Basic and should be easily modified to run on any system.

```
10      PRINT "MASTERMIND"
20      PRINT "HOW MANY NUMBERS"
30      INPUT B
40      M=2*B
50      R=0
60      FOR I=1 TO B
70      @(I)=RND(10)–1
80      NEXT I
90      PRINT "ENTER GUESS"
100     FOR I=B TO M
110     INPUT @(I)
120     NEXT I
130     C=A=0
140     FOR I=1 TO B
150     IF @(I)=@(I+B) THEN C=C+1:A=A–1
```

```
160     FOR J=B TO M
170     IF @(I)=@(J) THEN 190
180     NEXT J
185     GOTO 200
190     A=A+1
200     NEXT I
210     IF C=B THEN 260
220     PRINT "CORRECT POSITION =";C
230     PRINT "CORRECT BUT WRONG POSITION";A
240     R=R+1
250     GOTO 90
260     PRINT "CORRECT SOLUTION IS"
270     FOR I=1 TO B
280     PRINT @(I)
290     NEXT I
300     PRINT "NUMBER OF ATTEMPTS =";R
310     IF R>(3*N) THEN 340
320     PRINT "BUDDING GENIUS"
330     GOTO 440
340     IF R>(4*N) THEN 370
350     PRINT "NOT A BAD ATTEMPT"
360     GOTO 440
370     IF R>(5*N) THEN 400
380     PRINT "AVERAGE"
390     GOTO 440
400     IF R>(7*N) THEN 430
410     PRINT "RUBBISH"
420     GOTO 440
430     PRINT "EVER THOUGHT OF GOLF ?"
440     Y=1;N=0
450     PRINT "ANOTHER GAME, Y OR N"
460     INPUT A
470     IF A=1 THEN 10
480     STOP
```

Mr.J.HODGKINSON

Knight's Tour

The program solves the problem of how few moves need to be taken for a Knight to visit all the squares on a chess board. The program uses an iterative routine, always moving the piece to the square with the highest weighting factor. The program was written for a KIM 1 and uses the seven segment displays to show the number of squares visited and on the succesful completion of the tour the program may be modi—fied to display the squares visited.

```
DATA
0000    A1
0008    B1      Address of the 64 bytes allocated to the
0009    B2      chess board
000A    C1      Used to save the X and Y co—ordinates
000B    C2
000C    D1      Holds the value of the highest weighting
000D    E1      Count the number of moves
00F9    I1      LED display addresses
00FA    I2
00FB    I3
0100 to 013F    64 bytes of the chess board
```

```
CODE
        LDY     1
        STY     B2
        DEY
        STY     B1
        LDA     $7F
Z08     STA     (B1),Y  Each square is given a
        INY             weighting factor of 7F
        CPY     $40
        BNE     Z08
        CLD
        CLC
        LDA     0
        TAX
Z01     STA     A1,X    Locations 0000 to 0007
        ADC     8       are the start addresses of
        INX             each row of the board
        CPX     8       i.e. (0,0);(1,0);(2,0) etc
        BNE     Z01
Z14     LDX     7
        LDY     0       Knight starts at (7,0)
        STY     E1
Z04     INC     E1
        LDA     0
        STA     D1      X points at the appropriate row
        LDA     A1,X    of the board. i.e. the first co—ord
        STA     B1      inate.
        LDA     (B1),Y  A visited  square has its top bit set
        ORA     $80     making the wf negative
        STA     (B1),Y
        STY     C2
        STX     C1
        DEX             Move (X—1),(Y+2)
        INY
        INY
        JSR     Z02
        INX             Move (X+1),(Y+2)
        INY
        INY
        JSR     Z02
        DEX             Move (X—2),(Y+1)
        DEX
        INY
        JSR     Z02
        DEX             Move (X—2),(Y—2)
        DEX
        DEY
        JSR     Z02
        INX             Move (X+1),(Y—2)
        DEY
        DEY
        JSR     Z02
        DEX             Move (X—1),(Y—2)
        DEY
        DEY
        JSR     Z02
        INX             Move (X+2),(Y+1)
        INX
        INY
        JSR     Z02
```

```
        INX             Move (X+2),(Y-1)
        INX
        DEY
        JSR     Z02
        LDA     D1      If D1=0 no valid modes found
        BNE     Z03
        LDY     0
        STY     B1
Z12     LDA     (B1),Y  All those squares which have
        BPL     Z11     been visited have the top bit
        AND     $7F     removed and their wf reduced
        SBC     0       by 1
        CLC
        STA     (B1),Y
Z11     INY
        CPY     $40
        BNE     Z12
        JSR     Z05
        JMP     Z14
Z03     LDX     I2      Move Knight onto the appropriate
        LDY     I1      square
        JMP     Z04
Z02     CPX     8       If X or Y ≥8 then the move is
        BCS     Z06     off the board
        CPY     8
        BCS     Z06
        LDA     A1,X    If square has negative wf then
        STA     B1      it has already been visited
        LDA     (B1),Y
        BMI     Z06
        CMP     D1
        BEQ     Z06     Only updata I1,I2,D1 if the
        BCC     Z06     new wf is higher than any
        STA     D1      previous one
        STX     I2
        STY     I1
Z06     LDX     C1      Restore
        LDY     C2      X and Y
        RTS
Z05     LDA     E1
        STA     I3
Z17     CLI
        JSR     SCANS   Loop displaying last square
        BNE     Z17     visited and the number of
Z07     JSR     SCANS   squares visited until a key
        BEQ     Z07     is depressed
        JSR     SCANS
        RTS
```

The following modification allows the co-ordinates of each square visited to be displayed.

```
Z03     JSR     Z05
        LDX     I2
        LDY     I2
        JMP     Z04
```

Mr.P.M.JESSOP

Rendezvous

The object of the game is to rescue your companion who is floating in space '2001' style. You have only a limited amo-unt of fuel and time to rescue him. The thrusters may be on or off and the idea is to match your speed to that of the vic-tims. The game is easily modified to run on any system thanks to the mod-sheet and opens up the possibility of a graphics routine to simulate the rescue.

```
10 PRINT "TIME SPEED   APPROACH
   RANGE FUEL   TIME TO UPDATE"
20 F=50
30 T=0
40 V=0
50 S1=0
60 S2=100
70 U=10
80 PRINT "TIME?"
90 I=EXPR()
100 IF I>=0 GOTO 130
110 A=-1
120 GOTO 180
130 IF I<>0 GOTO 160
140 A=0
150 GOTO 180
160 IF I<=0 GOTO 999
170 A=1
180 D=ABS(I)
190 IF D<>0 GOTO 230
200 PRINT "SO TIME?"
210 D=EXPR()
220 D=ABS(D)
230 D=D-1
240 IF D<0 GOTO 80
250 T=T+1
260 V=V+A
270 F=F-(A*A)
280 IF F<0 GOTO 360
290 S1=S1+V
300 S2=S2+U
310 PRINT T "      " V "      "
    V-U "      " S2-S1 "      " F
    "      " D
320 IF T>=50 GOTO 440
330 IF ABS(S1-S2)>5 GOTO 230
340 IF ABS(V-U)>2 GOTO 230
350 PRINT "CONGRATULATIONS, YOU
    HAVE SUCCEEDED: FUEL
    REMAINING " F
360 GOTO 999
370 PRINT "YOUR FUEL IS EXHAUSTED"
380 IF V<0 GOTO 410
390 PRINT "YOU WILL FLOAT IN SPACE
    FOREVER"
400 GOTO 999
```

MODIFYING RENDEZVOUS FOR OTHER BASICS

EXISTING VERSION

```
...IF...GOTO...
80 PRINT "TIME?"
90 I=EXPR()

100 IF I>=0 GOTO 160
      TO
170 A=1

210 B=EXPR()

310 PRINT T "      " U "
```

VERSION FOR OTHER BASICS

```
...IF...THEN...
      SOME BASICS DON'T LIKE IF..GOTO
80 PRINT "TIME?";
      PUTS INPUT NUMBER ON SAME LINE.

90 INPUT I
      MUST BASICS WILL REQUIRE THIS.

90 INPUT "TIME?";I
      SOME WILL ALLOW THIS. LINE 90
      NOT THEN NEEDED.

100 A=SGN(I)
      SGN (SIGN) FUNCTION SOMETIMES AVAILABLE
      GIVES -1 IF NEGATIVE. 0 IF ZERO AND 1 IF
      POSITIVE.

210 INPUT B

 " V-U "     " S2-S1 "     " F "     " D
310 PRINT T;TAB(5);U;TAB(7);  ETC
      WHERE TAB(5) MEANS PRINT 5 SPACES
310 PRINT T;TAB(5);U;TAB(15);  ETC
      WHERE TAB(8) MEANS MOVE TO COLUMN 8. THIS
      WILL PRODUCE BETTER RESULTS.

990 PRINT "RENDEZVOUS COMPLETE"
      990 END
      NOT MANY BASICS STILL DEMAND THIS
```

```
410 PRINT "LUCKILY, YOU WILL COAST
    TO YOUR MOTHER SHIP BUT YOUR"
420 PRINT "COMPANION IS LOST"
430 GOTO 999
440 PRINT "TIME EXCEEDED"
450 GOTO 380
999 PRINT "RENDEZVOUS COMPLETE -
    GOODBYE"
```

Mr.W.MacDONALD

Double Dice

The program draws the result of two dice being thrown. The graphics are specific to the machine it was written for but we do not know which one it was. They should be easily adaptable to any processor.

```
10   A=RND(6), B=RND(6)
15   VDU 0,12
17   FOR I=1 TO 150;NEXT I
18   VDU 0,10
20   IF A=1 GOTO 100
30   IF A=2 GOTO 200
40   IF A=3 GOTO 300
50   IF A=4 GOTO 400
60   IF A=5 GOTO 500
70   IF A=6 GOTO 600
71   FOR I=1 TO 3; VDU 0,11; NEXT I
72   GOSUB 900
73   IF B=1 GOTO 730
76   IF B=2 GOTO 760
79   IF B=3 GOTO 790
82   IF B=4 GOTO 820
85   IF B=5 GOTO 850
88   IF B=6 GOTO 880
100  GOSUB 1000;GOSUB 1010;GOSUB 1000;GOTO 71
200  GOSUB 1030;GOSUB 1000;GOSUB 1040;GOTO 71
300  GOSUB 1030;GOSUB 1010;GOSUB 1040;GOTO 71
400  GOSUB 1020;GOSUB 1000;GOSUB 1020;GOTO 71
500  GOSUB 1020;GOSUB 1010;GOSUB 1020;GOTO 71
600  GOSUB 1020;GOSUB 1020;GOSUB 1020;GOTO 71
730  GOSUB 1000;GOSUB 900;GOSUB 1010;GOSUB 900
     GOSUB 1000;GOTO 890
760  GOSUB 1030;GOSUB 900;GOSUB 1000;GOSUB 900
     GOSUB 1040;GOTO 890
790  GOSUB 1030;GOSUB 900;GOSUB 1010;GOSUB 900
     GOSUB 1040;GOTO 890
820  GOSUB 1020;GOSUB 900;GOSUB 1000;GOSUB 900
     GOSUB 1020;GOTO 890
850  GOSUB 1020;GOSUB 900;GOSUB 1010;GOSUB 900
     GOSUB 1020;GOTO 890
880  GOSUB 1020;GOSUB 900;GOSUB 1020;GOSUB 900
     GOSUB 1020;GOTO 890
890  Y=1,N=0
893  INPUT "AGAIN ?  Y OR N"X
894  IF X=1 GOTO 10
895  STOP
900  FOR I=1 TO 8; VDU 0,9; NEXT I
```

```
901  RETURN
1000 PRINT "†††††"
1005 RETURN
1010 PRINT "††@††"
1015 RETURN
1020 PRINT "@†††@"
1025 RETURN
1030 PRINT "@††††"
1035 RETURN
1040 PRINT "††††@"
1045 RETURN
```

Note: † = SHIFT Z
@ = CONTROL S

Mr.G.PHILLIPS

Maze

The program is developed to run on an MK/14 but could be easily altered to suit any machine. The idea is to negotiate a maze without being eaten on falling down holes etc. To code your own mazes draw them out complete with the obstacles and code from start to finish including the comments on any obstacles etc. After hazards you can either return to the start or kill off the victim in an endless loop.

```
0F10                        Count –1, Count
0F12  C4 00 C8 FB           Initialise count 1 to zero
0F16  C4 0F 36
0F19  C4 80 32              Load maze address to P2
0F1C  C4 0D 37
0F1F  C4 00 33              Load display address to P3
0F22  C4 0B 35              Load message address to P1
0F25  C6 01 01 40           Get first maze section
0F29  31                    Also use as message pointer
0F2A  C4 08 C8 E4           Let count =8
0F2E  C5 01 CF 01           Load one character, display
0F32  8F 01                 Shine it
0F34  B8 DC 9C F6           Loop 8 times
0F38  C2 FF 31              Restore P1
0F3B  C4 00 33              Restore P3
0F3E  C2 00 9C 08           Is second part of maze code
0F42  B8 CD 9C E4           00, if not display message
0F46  C6 01                 Next part of maze
0F48  90 D8                 Go to 0F22
0F4A  C2 FF 94 02           If code positive jump 2
0F4E  90 04                 If code negative jump 4
0F50  D4 01 98 06           Odd or even, if even jump 6
0F54  C6 80                 Alter P2 accordingly
0F56  C6 FF
0F58  90 C8                 Next part of maze
0F5A  40 98 B9              If code 00xx back to start
0F5D  AB 00                 Input 0? INC P3, load
0F5F  98 04                 No input, jump 4
0F61  C6 01                 Continue in maze
0F63  90 06                 Jump 6
0F65  AB 01 9C 02           Input 1? Jump 2
0F69  90 BF                 Wait for decision
0F6B  8F FF                 Wait
0F6D  90 B3                 Back to 0F22, more maze
```

POINTERS

P1 Current message
P2 Maze position
P3 Keyboard / display
Note: Abort will not work as the monitor routine is not used. Maze from 0F80 onwards, could be relocated. Messages from 0B00 to 0BF8 as required.

LITERAL POOL FOR MESSAGES

Note: Not all of these are used in the example program, but should you wish to invent your own maze you could use them where you like. The ones used in the example are marked *

```
0B00                                    Not used
0B08* 00 76 76 76 76 76 76 77           'ahhhhhh'
0B10* 53 78 71 38 40 5E 50 71           'frd–lft?'
0B18* 53 78 50 40 5E 50 3F 71           'ford–rt?'
0B20* 53 78 50 40 78 71 79 38           'left–rt?'
0B28* 00 00 79 38 5E 5E 1C 73           'puddle'
0B30  5E 54 79 40 5E 77 79 5E           'dead–end'
0B38  6E 50 79 73 73 06 38 6D           'slippery'
0B40  73 1C 40 79 73 3F 38 6D           'slope–up'
0B48  00 38 38 06 76 73 1C 00           'uphill'
0B50  00 7C 1C 50 76 6D 00 00           'shrub'
0B58* 00 78 50 5E 54 79 7C 00           'bendrt'
0B60* 78 71 79 38 5E 54 79 7C           'bendleft'
0B68* 00 79 1C 78 77 78 6D 00           'statue'
0B70* 00 5E 54 79 00 79 76 78           'the end'
0B78  00 76 39 54 79 7C 00 00           'bench'
0B80* 00 00 78 50 77 78 6D 00           'start'
0B88* 79 76 78 5E 54 1C 3F 50           'roundthe'
0B90* 00 50 79 54 50 3F 39 00           'corner'
0B98* 00 00 5E 54 79 7C 00 00           'bend'
0BA0* 54 06 77 78 54 1C 3F 71           'fountain'
0BA8* 00 6F 54 06 54 50 1C 78           'turning'
0BB0* 00 00 5E 54 1C 3F 50 00           'round'
0BB8  00 50 79 6F 06 78 00 77           'A tiger'
0BC0* 54 3F 06 38 00 79 76 78           'the lion'
0BC8* 1C 3F 6E 00 6D 78 77 79           'eats you'
0BD0* 79 6D 3F 38 00 1C 3F 6E           'you lose'
0BD8  00 5E 54 1C 3F 50 6F 00           'ground'
0BE0  00 00 6E 5E 5E 1C 55 00           'muddy'
0BE8* 00 6D 6D 79 38 5E 54 79           'endless'
0BF0* 00 00 00 78 06 73 00 00           'pit'
```

EXAMPLE MAZE

```
0F80  80 00 18 41 A0 00 18 45
      68 00 10 55 88 00 90 00
0F90  18 0F 10 09 C0 00 C8 00
      D0 00 00 01 20 E7 E2 01
0FA0  20 35 88 00 98 00 10 35
      58 00 18 F7 20 E5 60 00
0FB0  18 2F 68 00 10 17 A8 00
      88 00 90 00 A0 00 60 00
0FC0  10 03 BE 01 20 03 CE 01
      10 D7 E4 01 20 03 DA 01
```

```
0FD0   A8 00 90 00 20 D7 60 00
       18 03 F6 01 20 AB D8 01
0FE0   20 05 70 00 00 01 E8 00
       F0 00 08 00 D0 00 00 01
```

Mr.Q.A.RICE

The following five programs are all written for the TRITON and are really intended for use as routines within other programs.

Factorials (Limit of seven with Tiny–BASIC)

```
10   INPUT "FACTORIAL OF" , N
20   X=1
30   FOR Y=N TO 2 STEP –1
40   X=X*Y
50   NEXT Y
60   PRINT X
70   GOTO 10
```

Square Roots (Integer result with Tiny–BASIC)

```
10   INPUT "THE SQUARE ROOT OF" , X
20   Y=0,Z=170
30   Z=((X/Z)Z)/2
40   IF Z*Z=X PRINT "=" , Z;GOTO 10
50   Y=Y+1
60   IF Y=15 PRINT "NEAREST INTEGER":,Z;GOTO 10
70   GOTO 30
```

Clock (Adjust line 80 for accuracy)

```
10   INPUT "HOURS"A,"MINUTES"B
20   C=0
30   PRINT A, // 4,B, // 4,C
40   C=C+1
50   IF C=60,C=0,B=B+1
60   IF B=60,B=0,A=A+1
70   IF A=13,A=1
80   FOR X=1 TO 330
90   NEXT X
100  GOTO 30
```

Spiral Screen Wipe

```
10   VDU 0,12
20   A=1,B=64,C=1024,D=961
30   FOR W=A TO B
40   VDU W,122;NEXT W
50   FOR X=B TO C STEP 64
60   VDU X,122;NEXT X
70   B=B+63
80   FOR Y=C TO D STEP–1
90   VDU Y,122;NEXT Y
100  C=C–65
110  FOR Z=D TO A STEP–64
120  VDU Z,122;NEXT Z
130  D=D–63,A=A+65
140  GOTO 30
```

Chess Board

```
10   VDU 0,12
20   X=32
30   FOR A=1 TO 8
40   FOR B=3 TO 10
50   FOR C=1 TO 3
60   VDU (A*64)+(B*3)+C,X
70   NEXT C
80   GOSUB 130
90   NEXT B
100  GOSUB 130
110  NEXT A
120  STOP
130  IF X=32,X=122;RETURN
140  IF X=122,X=32;RETURN
```

Mr.I.POWELL

File Finder

The program is in machine code for the TRITON and is designed to allow the user to list the names of files on a tape recorded in TRITON format. It is designed to be recorded onto and recovered from tape using the monitor. The start address is at 1602H, bytes 1600H and 1601H containing the length code for the monitor tape I/O routines. When the program switches on the tape recorder it starts to look for a file header, which in TRITON format consists of 64 CR characters followed by the file identifier terminated with an EOT character. Having found the 64 CR's the program prints the file identifier on the VDU and searches for the next one on the tape. This continues until the character M is pressed on the keyboard. It is a good idea to load this program onto the start of each tape.

```
0000                        ORG     1600H
1600  4D16                  DB      4DH,16H

                  TPEON     EQU     0327H
                  RST2      EQU     0010H
                  TPEOFF    EQU     032CH
                  OUTCH     EQU     0013H

1602  CD2703                CALL    TPEON
1605  CD3616      START:    CALL    TPEIN
1608  FE0D                  CPI     0DH
160A  C20516                JNZ     START
160D  063F                  MVI     B,63
                    INC:
160F  CD3616                CALL    TPEIN
1612  05                    DCR     B
1613  FE0D                  CPI     0DH
1615  C20516                JNZ     START
1618  78                    MOV     A,B
1619  FE00                  CPI     0
161B  C20F16                JNZ     INC

161E  3E0D                  MVI     A,0DH
1620  CD1300                CALL    OUTCH
1623  3E0A                  MVI     A,0AH
1625  CD1300                CALL    OUTCH
1628  CD3616      WRT:      CALL    TPEIN
162B  FE04                  CPI     04H
162D  CA0516                JZ      START
1630  CD1300                CALL    OUTCH
1633  C32816                JMP     WRT
```

```
                    TPEIN:
1636    DB00                IN      0
1638    FEED                CPI     0EDH
163A    CA4716              JZ      EXIT
163D    DB01        LOOP:   IN      1
163F    E601                ANI     1
1641    CA3616              JZ      TPEIN
1644    DB04                IN      4
1646    C9                  RET
1647    CD2C03      EXIT:   CALL    TPEOFF
164A    C31000              JMP     RST2
                            END.

B               0000        A               0007
C               0001        B               0000
D               0002        C               0001
E               0003        D               0002
H               0004        E               0003
L               0005        EXIT            1647
M               0006        H               0004
PSW             0006        INC             160F
SP              0006        L               0005
A               0007        LOOP            163D
TPEON           0327        M               0006
RST2            0010        OUTCH           0013
TPEOFF          032C        PSW             0006
OUTCH           0013        RST2            0010
START           1605        SP              0006
INC             160F        START           1605
WRT             1628        TPEIN           1636
TPEIN           1636        TPEOFF          032C
LOOP            163D        TPEON           0327
EXIT            1647        WRT             1628
```

Submarine Game

The game is designed for the TRITON and written in tiny–BASIC. It simulates the hunting of an unseen submarine by a destroyer, given only the submarine's last bearing and distance. The object is to destroy the sub, guided by sonar, and you have 20 depth charges to do so. The program takes just under 2K of memory. There are three levels of skill, Novice, Moderate and Expert. The game is played on a grid of 1–14 Northings and 1–60 Eastings. The sub moves S grid units in a random direction, unless disabled, between every attempt. If the sub leaves the grid it reappears on the other side, if it does this more than 4 times you lose. If you drop a charge within 4–S grid units of the sub it is disabled and cannot move. A direct hit will sink the sub. To drop charges give the position in Northings (NL) and Eastings (EL). For each charge dropped there is a simulated explosion at that position, a dot is left to mark the spot. After each attempt you are given the distance from that charge and the bearing to the sub. At the end of the game you may obtain the subs course labelled A,B,C etc. with a * showing the last position. Good hunting !

```
20 Z=0,W=0,R=1
30 V=2
50 VDU 0,12
55 GOSUB 770
60 P.'YOU HAVE 20 DEPTH CHARGES TO SINK THE SUB'
62 P.'POSITIONS GIVEN IN NORTHLINGS   EASTLINGS'
64 P.'IF SUB.ESCAPES AREA IT RE-ENTER'S ON THE OTHER SIDE'
65 P.'IF THIS HAPPENS MORE THAN 4 TIMES YOU LOSE'
66 P.'SUB.MOVES UNTIL DISABLED'
67 P.
70 P.'ENTER YOUR DEGREE OF SKILL'
90 INPUT '1=NOVICE:2=MODERATE:3=EXPERT'S
91 A=RND(8)
93 X=RND(15-S*2)+S
96 Y=RND(60-S*2)+S+1
100 IF(S>0)*(S<4) GOTO 130
110 P.'MUST BE 1,2 OR 3'
120 GOTO 90
130 E=4-S
140 VDU 0,12
150 GOSUB 770
160 VDU 0,10
165 P.'  1   5',
170 FOR I=10 TO 60 STEP 5
180 P.#5,I,;NEXT I
190 VDU 0,13
200 FOR I=14 TO 2 STEP -1
210 P.#2,I
220 NEXT I
225 P.' 1',
230 GOSUB 760
234 IF Z>4 GOTO 500
236 IF R>20 GOTO 512
260 @(R)=X*64+Y
270 R=R+1
275 P.' POSITION',
277 V=V-2
280 VDU 0,29
282 F.J=1TO50;VDU 0,9;N.J
283 INPUT 'NL='H
284 VDU 0,11
285 F.J=1TO57;VDU 0,9;N.J
286 P.#6,V,^H,^H,^H,^H,^H,^H,;INPUT 'EL='V
287 VDU 0,11
288 H=16-H,V=V+2
290 IF(H>1)*(H<16)*(V>2)*(V<63) GOTO 312
300 P.'POSITION OUT OF AREA',
310 GOTO 280
312 U=H*64+V
314 VDU U,42;F.I=1TO200;N.I
316 VDU U,15;F.I=1TO200;N.I
318 VDU U,18
320 GOSUB 760
322 W=W+1
325 IF (H=X)*(V=Y) GOTO 520
340 L=ABS(X-H)
350 M=ABS(Y-V)
360 IF(L<=E)*(M<=E) S=0
370 IF S=0 P.'"DISABLED" ',
380 GOSUB 620
400 A=A+RND(3)-2
403 IF A>8 A=A-8
406 IF A<1 A=A+8
410 X=X+S*((A<=3)-(A>=5)*(A<=7))
420 Y=Y+S*((A>=3)*(A<=5)-(A=7)-(A=8)-(A=1))
425 U=0
430 IF X<2 X=X+14;U=1
440 IF Y<3 Y=Y+60;U=1
450 IF X>15 X=X-14;U=1
460 IF Y>62 Y=Y-60;U=1
470 IF U Z=Z+1
480 GOTO 234
500 GOSUB 790;P.'YOU LOST HE GOT AWAY ',
510 GOTO 540
512 GOSUB 790;P.'OUT OF DEPTH CHARGES ',
514 GOTO 540
520 GOSUB 790;P.'YOU SUNK IT WITH ',#2,W,' DEPTH CHARGES',
540 Y=2,N=1
545 INPUT' SUBS COURSE? Y OR N'C
550 IF C=1 G.585
560 FOR I=1 TO R-1
570 VDU @(I),I+64
575 VDU @(R-1),42
580 NEXT I
585 GOSUB 790
590 INPUT 'NEW GAME Y OR N'C
600 IF C=Y GOTO 20
610 STOP
620 I=H-X,J=V-Y
640 U=I*I+J*J
650 FOR D=1 TO 90
670 IF D*D>U GOTO 690
680 NEXT D
690 D=D-1
700 P.#2,'LAST BEARING=',D,
710 IF X<H P.' NORTH',
720 IF X>H P.' SOUTH',
725 IF X=H P.'      ',
730 IF Y>V P.' EAST',
740 IF Y<V P.' WEST',
745 IF Y=V P.'      ',
750 R.
760 VDU 0,28
770 F.I=1 TO 150;N.I
780 R.
790 GOSUB 760;P..;VDU 0,13
800 VDU 0,11
810 R.
```

MR.P.CORNES

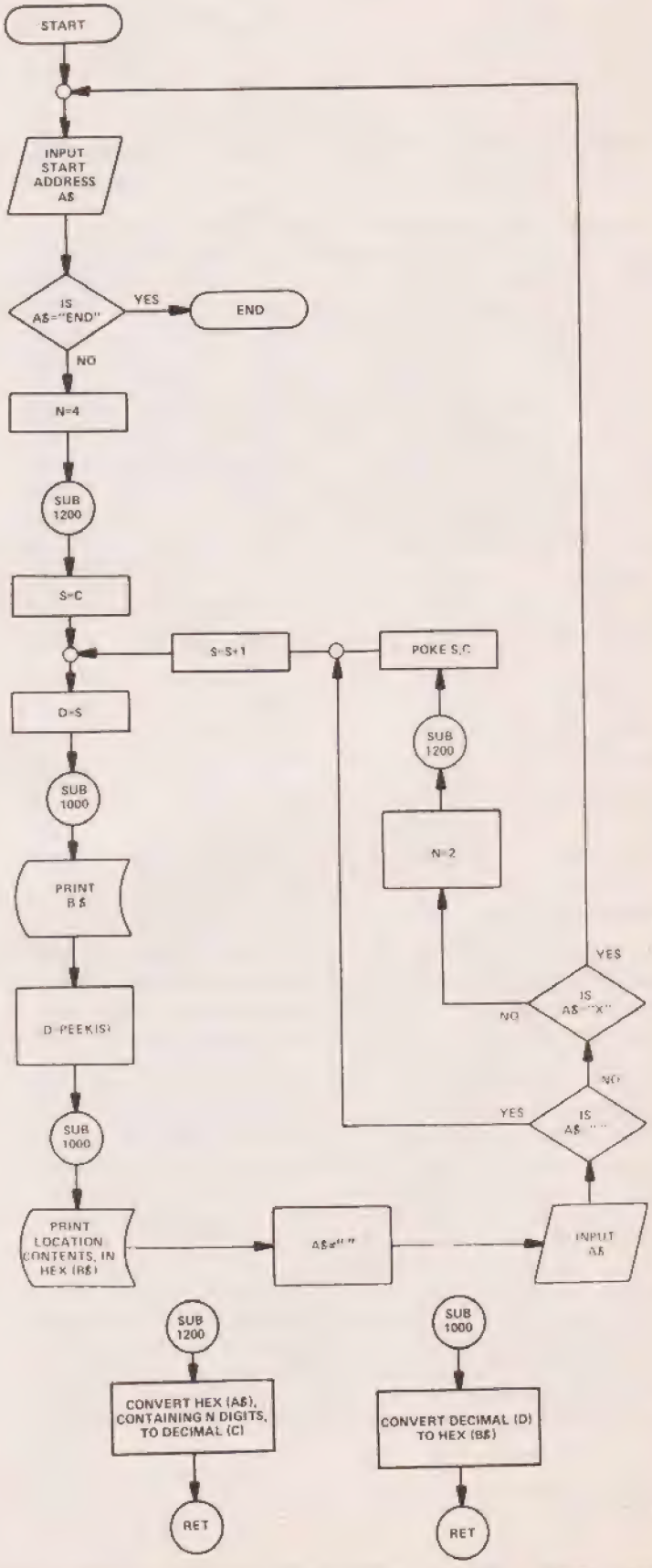
Hex–Bug

There are quite a few micro–computers on the market now which will run extended BASIC and so have PEEK and POKE statements in their vocabulary. The program listed here here uses these two facillities to overcome a small but annoying problem that most of these micro–computers share. It is possible using the PEEK and POKE statements to write machine code subroutines in BASIC programs but using these statements you have to input the data in decimal number format.This program allows you to enter, modify and list your machine–code subroutines in HEX instead of decimal.

When you run this program you will be asked to "Input start address". At this point you should type in a four digit HEX number which will be taken as the first add–ress you wish to examine; (You could also type END at this point which will terminate the run)The computer will respond to this by displaying the chosen address (HEX four digits) and along side it, the contents of that address (HEX – two digits). After this a question mark will be dis–played. If you are happy with the contents of the location displayed then just press carriage return and the process will be repeated with the next higher numbered location. If you wish to change the contents of the displayed location then just type in (HEX – two digits) the contents of this location as you would wish to be. The third alternative is to type ,X when you have finished working on your prog – ram and this will cause the computer to exit back to "Input start address".

A flow chart of the program is included for those of you who enjoy mental gymnastics or for those of you who may wish to improve the program or add more facilities to it.

```
10      PRINT" ––CTI HEX–BUG––"
20      INPUT"INPUT START ADDRESS (HEX –
        4 DIGITS) OR TYPE END";A$
25      IF A$= "END" THEN END
30      N=4 : GOSUB 1200
40      S=C
50      D=S :GOSUB 1000
60      PRINT B$;"  ";
70      D=PEEK(S) : GOSUB 100
80      PRINT MID$(B$,3,2); "  ";
90      A$=" " : INPUT A$
100     IF A$=" " THEN 140
110     IF A$="X" THEN 20
120     N=2 : GOSUB 1200
130     POKE S,C
140     S=S+1 : GOTO 50
1000    B$=" " : K=4
1010    Q=↑6↓(K–1) : L=0
1020    IF Q>D THEN K=K–1 : IF K=–1 THEN 1060
        ELSE 1040
1030    L=L+1 : D=D–Q :GOTO 1020
1040    IF L>9 THEN L=L+ 55 ELSE L=L+48
1050    B$=B$+CHR$(L) : GOTO 1010
1060    RETURN
1200    C=0 : FOR A=1 TO N
1210    B=ASC(MID$(A$,N+1–A, ))
1220    IF B>57 THEN B=B–55 ELSE B=B–48
1230    C=C+B*16↓(A–1)
1240    NEXT A : RETURN
1250    END
```



Mr.S.AINSWORTH

Computer Tolinka

This program was produced after reading the articles on the "Tolinka" chess recorder in ETI. The program has been produced on a Systime RSTS–11 time–sharing system that used a 25 by 80 character VDU, this point should be borne in mind when making any alterations to the program. The philosophy behind the program is that as a chess game machine is designed specifically for the purpose of 'chess logic', a micro is not and is therefore very inefficient. The program therefore is used exactly as Tolinka would be, that is as a game recorder. The main features of the program are as follows:–

1) Very clear display of board positions.
2) Last 36 moves displayed on the screen.
3) Input from terminal/file to terminal/file.
4) Set and reset functions. You can enter SET and try out a line of thinking without the movements of the pieces being entered into the command matrix, C$(), or the output device file. Enter RESET and the pieces are returned to their original positions and the output is re-enabled.
5) Castling and all other moves are single algebraic notation commands, row numbers and file letters are displayed on the screen.
6) Upper and lower case commands are understood.
7) Rudimentary checking of commands for illegal moves.
8) Fast operation due to short program length, 4K.

The screen display is shown with the currently made moves on the left hand side of the chessboard. The listing of table 1 is a sample of a stored game which could be recalled and re–played.

```
1       !MULTI-ROLE CHESS PROGRAMME BY S.AINSWORTH MATHS SIXTH
4       !INITIALISATION
5       ON ERROR GOTO 10000:Y%=SYS(CHR$(6%)+CHR$(-7%))
10      OPEN"CHESS.INN" AS FILE 1%:
         DIM I%(24%,7%),A%(24%,3%),C$(30%),M%(8%,8%)
15      INPUT"INPUT DEVICE/FILE";I1$:INPUT"OUTPUT DEVICE/FILE";O1$:
         OPEN I1$ AS FILE 2%:OPEN O1$ AS FILE 3%
20      FOR I%=1% TO 8%:FOR J%=1% TO 8%:INPUT LINE #1% A$
25      READ M%(I%,J%) UNLESS 2%<I% AND I%<7%
30      I%(I%,J%)=LEFT(A$,LEN(A$)-2%):NEXT J%:NEXT I%
40      &CHR$(24%)+"          "+CHR$(14%)+" CHESS "+CHR$(15%)+"     ";:
         &"       "+CHR$(I%);FOR I%=97% TO 104%:&;:&;:&"       WHITE    BLACK"
50      &CHR$(30%)+CHR$(33%)+CHR$(3%*I%+31%)+NUM$(9%-I%) FOR I%=1% TO 8%
60      FOR I%=1% TO 8%:FOR J%=1% TO 8%:IF I%+J%<>2%*INT((I%+J%)/2%) THEN
         M$(I%*3%-1%,J%)=I$(I%,J%):M$(I%*3%-2%,J%),M$(I%*3%,J%)="       ":GOTO 80
70      M$(I%*3%-2%,J%),M$(I%*3%,J%)="*******":
         IF I$(I%,J%)=CHR$(15%)+"       "THEN M$(I%*3%-1%,J%)=CHR$(15%)+"*******"
         ELSE M$(I%*3%-1%,J%)=I$(I%,J%)
80      GOSUB 150
85      NEXT J%:NEXT I%
95      !INPUT FROM TERMINAL/FILE FOR NEXT MOVE
100     &CHR$(30%)+CHR$(32%)+CHR$(55%)+SPACE$(21%)+CHR$(13%);:
         IF C% THEN &"BLACK"; ELSE &"WHITE";
101     &"'S MOVE:";:INPUT LINE #2%,A1$:A1$=LEFT(A1$,LEN(A1$)-2%):GOTO 4000
```

Table 1.

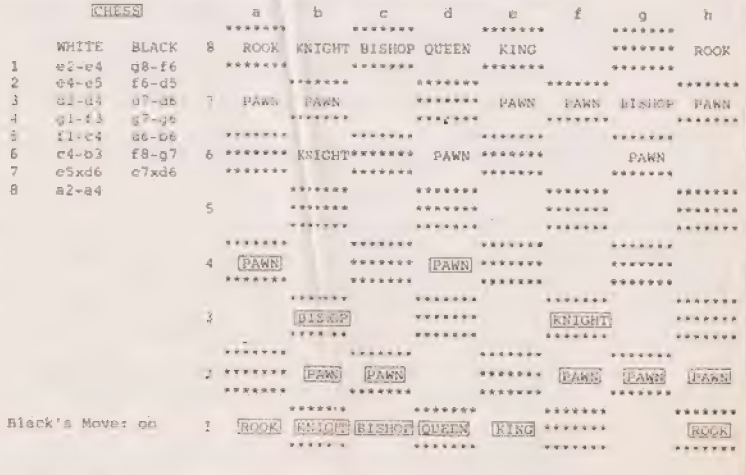
```
E2-E4  C7XD5  D4XE5
G8-F6  A2-A4  G7XF6
E4-E5  00     F1-E1  D8-D7
F8-D8  00     E5-C7  A1-A4
D2-D4  B8-C6  B3XD5  F8XC7
D7-D6  H2-H3  D8-D8  F4XC7
G1-F3  C8-F5  G2-G3  D7XC7
G7-G6  A4-A5  A8-B8  A4-H4
F1-C4  B8-C8  B1-C3  G8-E8
D5-B6  D1-D2  F8XH3  D5-E4
C4-B3  D8-D5  D2-H6  C2XE4
F8-G7  F3-E5  H3-F5  E1XE4
E5XD8  C8XE5  C1-F4  FILE-R
```

```
                CHESS

     WHITE     BLACK
1    e2-e4     g8-f6
2    e4-e5     f6-d5
3    d2-d4     d7-d6
4    g1-f3     g7-g6
5    f1-c4     d6-b6
6    c4-b3     f8-g7
7    e5xd6     c7xd6
8    a2-a4

Black's Move: on

Note: [PAWN] indicates reversed vide.
```



```
103     & A1$ UNLESS  11%="KB:"
105     &CHR$(26%);:SLEEP 3% UNLESS I1%="KB:";&SPACE%(21%):
         GOSUB 1000 UNLESS 5%
110     IF X1%=15% THEN GOSUB 3000 ELSE GOSUB 2000
120     C%=1%-C%:GOTO 100
140     !BOARD PRINTOUT SUBROUTINE
150     &CHR$(30%)+CHR%(49%+J%*7%)+CHR$(3%*I%+K%+29%)+M%(3%*I%-3%+K%,J%)+
         CHR$(26%) FOR K%=1% TO 3%:RETURN
990     !COMMAND MATRIX SUBROUTINE
1000    IF LEN(C$(36%)) THEN C$(I%)=C$(I%+2%) FOR I%=1% TO 34%:
         C$(35%)=A1$:C$(36%)="":11%=I1%+1%:GOTO 1030
1010    FOR I%=1% TO 36%:IF LEN(C%(I%))=0% THEN C%(I%)=A1%:GOTO 1030
1020    NEXT I%
1030    FOR I%=1% TO 18%:IF C%(2%*I%-1%)="" GOTO 1040
         ELSE &CHR%(30%)+CHR%(32%)+CHR$(35%+I%)+NUM$(I1%+I%);
1035    &SPACE$(5%-LEN(NUM%(I1%+I%)))+C$(2%*I%-1%)+SPACE$(8%-LEN(C$(2%*I%-1%)))+
         C$(2%*I%)+SPACE$(8%-LEN(C%(2%*I%))):NEXT I%
1040    &£3%,A1$ UNLESS 01%="KB:":RETURN
1990    !MOVING SUBROUTINE
2000    M$(Y2%*3%-1%,X2%)=M%(Y1%*3%-1%,X1%):
         IF X1%+Y1%<>2%*INT((X1%+Y1%)/2%) THEN M$(Y1%*3%-1%,X1%)=CHR%(15%)+
         "       " ELSE M$(Y1%*3%-1%,X1%)=CHR%(15%)+"********"
2010    IF S%=0% THEN M%(Y2%,X2%)=M%(Y1%,X1%):M%(Y1%,X1%)=0%
2015    I%=Y1%:J%=X1%:GOSUB 150
2017    I%=Y2%:J%=X2%:GOSUB 150
2020    RETURN
2990    !CASTLING SUBROUTINE
3000    X1%=5%:IF C% THEN Y1%=1% ELSE Y1%=8%
3010    Y2%=Y1%:IF ASCII(RIGHT(A1$,3%)) THEN X2%=3% ELSE X2%=7%
3015    GOSUB 2000
3020    IF X2%=3% THEN X1%=1%:X2%=4%:GOTO 3035
3030    X1%=8%:X2%=6%
3035    GOSUB 2000
3040    RETURN
3990    !COMMAND CHECKING ROUTINE
4000    X1%=(223% AND ASCII(A1$))-64%:Y1%=57%-ASCII(RIGHT(A1$,2%)):
         X2%=(223% AND ASCII(RIGHT(A1$,4%)))-64%:Y2%=57%-ASCII(RIGHT(A1$,5%))
4010    IF X1%=6% AND (Y1%<0% OR Y1%=57%) GOTO 103
4020    IF X1%=19% THEN I%(I%,J%)=M%(I%,J%) FOR I%=1% TO 24% FOR J%=1% TO 8%:
         S%=1%:C1%=C%:GOTO 100
4030    IF X1%=18% THEN M%(I%,J%)=I%(I%,J%) FOR I%=1% TO 24% FOR J%=1% TO 8%
         ELSE GOTO 4055
4040    FOR I%=1% TO 8%:FOR J%=1% TO 8%:GOSUB 150
4050    NEXT J%:NEXT I%:S%=0%:C%=C1%:GOTO 100
4055    IF X1%=15% GOTO 4090
4060    F%=M%(Y1%,X1%):T%=M%(Y2%,X2%):O%=223% AND ASCII(RIGHT(A1$,3%))
4070    IF O%=13% AND (F%=0% OR T% OR SGN(F%)<>SGN(C%-.5))
         THEN &CHR$(26%)+"     "+CHR%(14%)+"MOVE ";:GOTO 4100
4080    IF O%=88% AND (SGN(F%)<>SGN(C%-.5) OR T%=0% OR SGN(T%)=SGN(F%))
         THEN &CHR$(26%)+"     "+CHR$(14%)+"MOVE ";:GOTO 4100
4090    GOTO 103
4100    &"ERROR"+CHR$(15%)+CHR$(7%)+"     .":SLEEP 2%:GOTO 100
9980    !DATA
9990    DATA 5,2,4,6,9,4,2,5,1,1,1,1,1,1,1,1
9991    DATA -1,-1,-1,-1,-1,-1,-1,-1,-5,-2,-4,-8,-9,-4,-2,-5
9995    !ERROR HANDLING ROUTINE
10000   IF ERR=28% THEN Z%=SYS(CHR$(0%))
10010   IF ERR=26% AND I1%<>"KB:" THEN CLOSE 2%:OPEN"KB:" AS FILE 2%:
         I1$="KB:":Y$=SYS(CHR$(6%)+CHR%(-7%)):RESUME 100
10020   IF ERR=55% THEN &;&"END OF GAME DATA":SLEEP 5%:&CHR$(24%)
10030   CLOSE 1%,2%,3%
10040   IF ERR=11% OR ERR=26% THEN KILL 01$:&CHR$(24%)
10050   END
```

Hey Prestel! Viewdata comes home at last

The Post Office Viewdata system, known as Prestel, is now available in the London area to residential users. The system uses two devices common in most homes nowadays, the telephone and the TV. By connecting these together the Post Office has gained a world lead in information distribution to the general public, the businessman and many other groups of users.

The concept of providing information on a vast, readily accessible scale first appeared with the Teletext systems introduced a couple of years ago by the BBC and the IBA. However the amount of data that these can actually distribute is limited by two factors, the available transmission space on the TV (which is two lines of the 625) and the time taken to access any given piece of information.

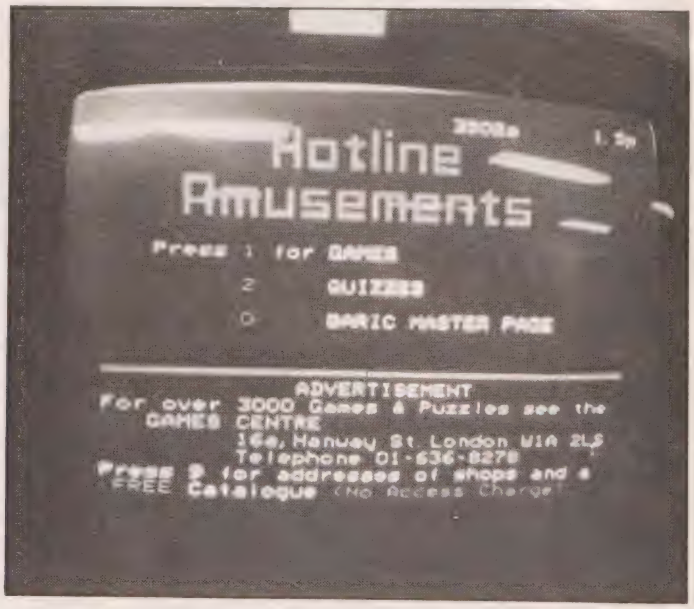
The Teletext database is limited by these two constraints to about 3-4 hundred pages, screenfuls, of information. The Prestel database currently stands at 146,000 pages and is growing at the rate of 10,000 pages per month.

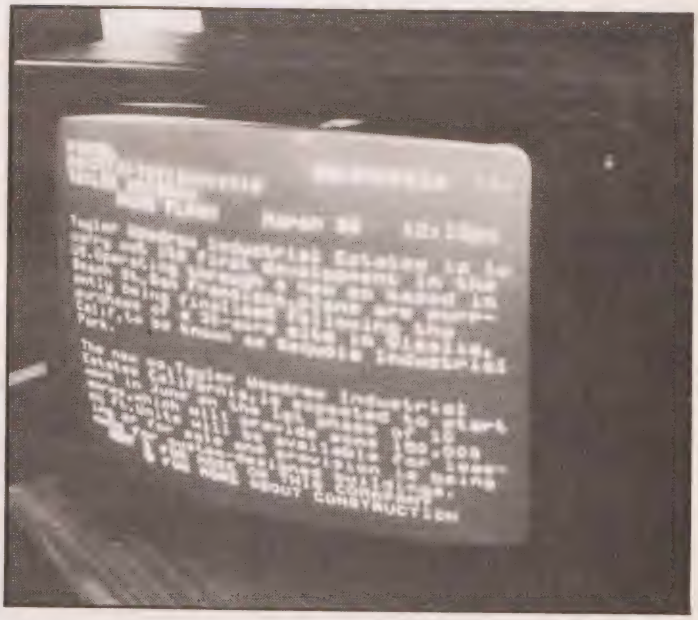
Spice Of Life

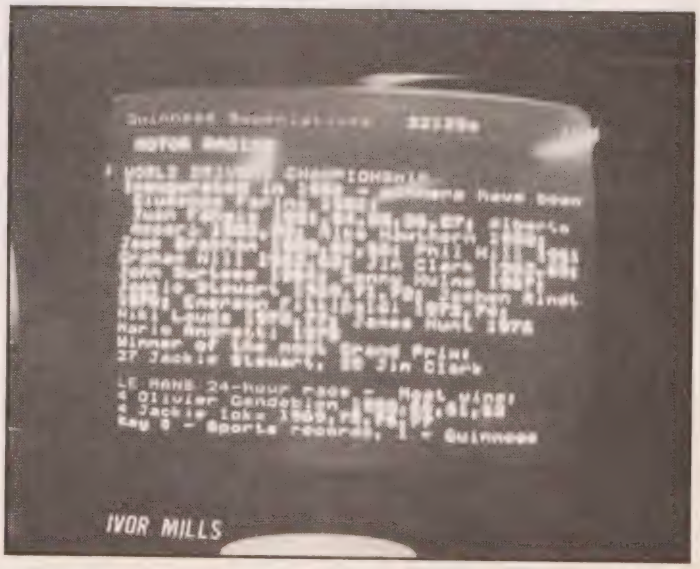
The variety of information available is vast, ranging from British Airways timetables to the latest company reports from the Stock Exchange. Actual connection to the system requires a modified TV, such as the one in Photo 1, which costs about £900 and a telephone.

The TV contains a modem and all the decoding circuitry to convert the serially transmitted data on the telephone line into a pageful of information. The TV will also allow access to the Teletext system. The outstanding difference between the two systems is not only that Prestel provides a much larger, and faster, database but that the concept is *two way*.

A user with an intelligent terminal, or even the TV







The pictures on these two pages show the variety of information available. From top right clockwise. The games index page from BARIC, a FINTEL company report, the World Driver Championship table and a Met Office bulletin.

keypad, actually asks the mainframe computer at the other end of the telephone line for the data he wants. Once you have 'logged on' to the system you are presented with a series of index pages which prompt you to enter a number from your keypad corresponding to the type of information that you require. As an alternative to this method of finding data, which is time consuming, you may look up the required data in a directory, not unlike a normal telephone directory, and dial the page number of the required data.

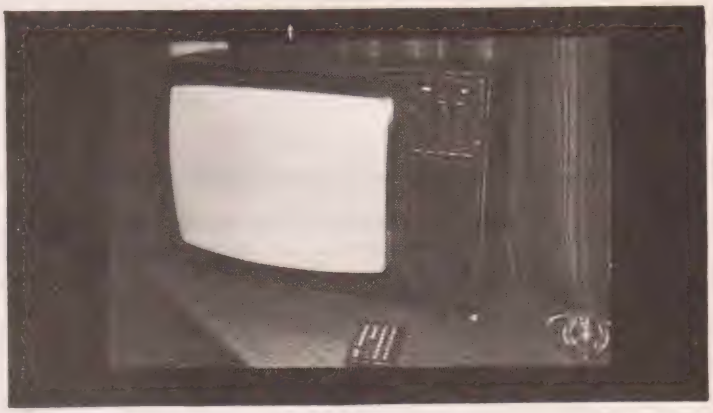
Now, rather than having to wait for the required page to be cycled to you as with the Teletext systems, the computer retrives the data from its store and sends it back down the line. This makes the system much faster and also opens up rather interesting possibilities. Because you now have access to the database you could create your own pages on the system for other people to read — electronic mail becomes a possibility.

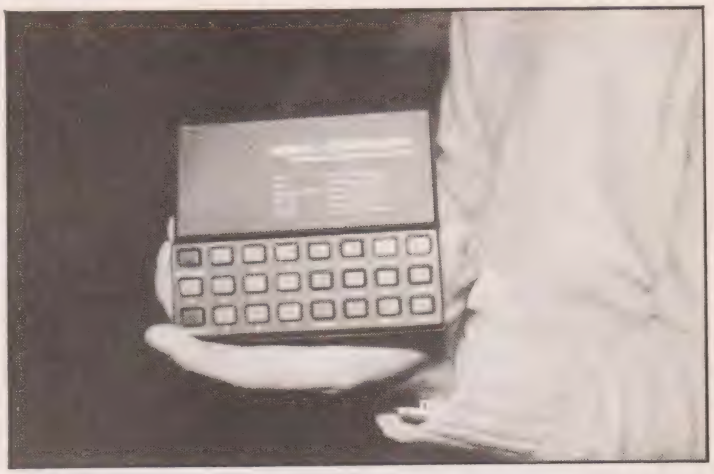
You can also access software stored on the system to run on your own computer at home.

Rent A Cost

The actual cost of obtaining the information stored is made up of several components. Primarily there is the cost of making the phone call to the system and finally there is a charge for the actual information that you access. The cost of the TV will undoubtedly come down over the next few years but in the meantime you may rent a set rather than buy. Radio Rentals are currently offering sets at £24 per month.

The charge for the telephone call will be that of a local call, unless there is no Prestel computer in the area. It is hoped that most areas will be within the range of a computer in the not too distant future. Plans are altready in





Above: One of the Baric games on the system.
From top to bottom: Dr Alex Reid demonstrating the system at the launch . One of the GEC sets with its remote control.
The ITT remote control keypad showing the Prestel and Teletext page selection controls. An ITT set showing the remote control plugged to act as the standard TV controls.

the pipeline for centres in several major cities. The cost of accessing the data itself is set by the Information Provider, along with a fixed charge of 3p minute in business hours and 3p/3 minutes at other times, and can vary from zero to 50p.

This charge can be quoted before you actually obtain the information, thus preventing large unwarranted charges. If you think that the charges are high consider this; if you want specific data on a topic you will have to *pay* for it whether you buy a book or a newspaper. Any information will cost you money and a vast database such as that on Prestel would be almost impossible to own privately, thus for access directly to the data you want the charges are almost certainly not unreasonable.

It must be admitted that if you wandered at random through the database playing games or reading jokes you would probably get a nasty shock when your telephone bill arrived!

Future Call

It is quite conceivable that in the next five years home computers will have direct access to Prestel as a matter of course, and the exchange of software and information will be a booming business. The Post Office prediction for the database is 1 million pages in five years and with the present rate of growth this figure seems reasonable. The system is already being exploited abroad with Holland, Germany and Hong Kong all setting up. America has signed a licence agreement and France is in the process of developing its own system. The future of 'informatics' is ensured, at least in this country, and the possibility of global networks is more than mere speculation.

We can only wish the Post Office the best of British and hope that yet another development from this country prospers overseas as well as at home.

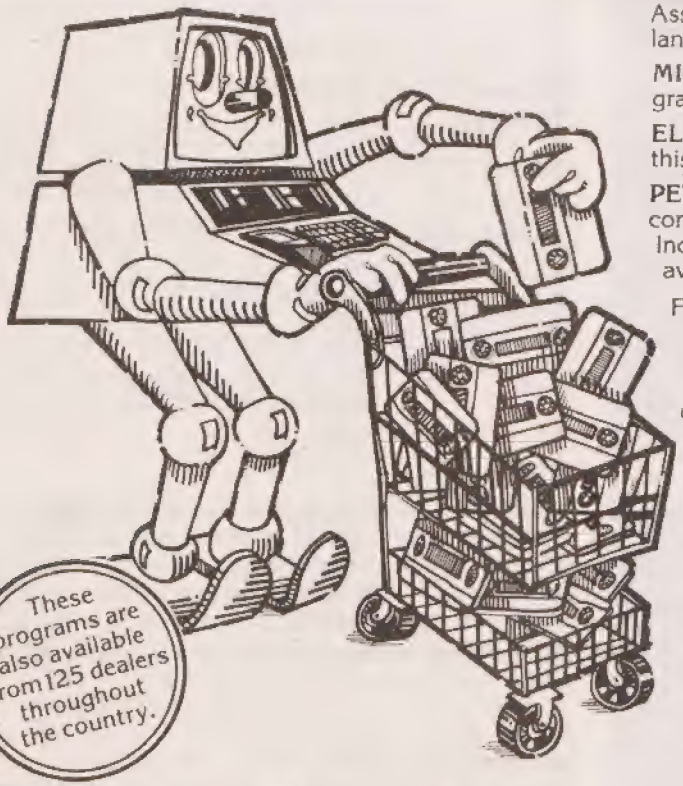
Pet program supermarket

At last a whole menu of programs to feed your PET at prices which knock the bottom out of traditional software costs.
Our 16 page catalogue lists nearly 130 programs from £3 to £50 (including VAT). These cover Business Routines, Programming Aids to help you make the most of your PET and some super games to play with it. Here are just a few examples.

MAILING LIST—£15. Stores and prints names and addresses; carries out labelling etc.

INVOICING—£20. Stores pricing information and prints numbered invoices. Handles differing VAT rates, and at least 50 items on 8k PETS; more with additional memory.

WORD PROCESSOR—£25. Composes, edits and prints letters, articles, leaflets etc. Script directives include line length, left margin, centering and skip. Edit commands allow user to insert, delete and move lines, change strings, save and load from cassette, move up and down, print and type. Addresses any RS-232 printer through special adaptor, available separately.



These programs are also available from 125 dealers throughout the country.

V.A.T. PACK—£17.50. Two programs, one for output VAT and one for input VAT. Allows data to be entered, processed and stored on tape. Information, including VAT return, can be displayed at any time. 'VAT SCHEME D' is also available for retailers, price £15.00.

STOCK CONTROL—£12. Stores up to 150 items per tape file, under stock number, description, suppliers name and address, and stock level. Auto re-order warning.

MERGE—£8. Joins any program or section to another.

PET BASIC TUTORIAL—£15. Let your PET teach you to program in BASIC. A complete course.

ASSEMBLER/EDITOR—£25. One and two pass Assemblers, Editor and Executor translates assembly language programs into machine code for direct execution.

MICROCHESS—£14. Play chess against PET. Excellent graphics. A superb piece of programming.

ELIZA/DOCTOR—£10. PET converses "intelligently" in this famous simulation of a consultation, with a psychiatrist.

PET WORKBOOKS—£15. Five workbooks provide a comprehensive introduction to PET programming. Includes many examples and exercises. Now Volume 6 available, price £3.00.

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COMING SOON Programs for Apple and TRS 80

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Tel: 021-454 5348 Telex: 339396.
Petsoft A member of the ACT Computer Group.
PET is the trade mark of Commodore

To Petsoft 5-6 Vicarage Rd., Edgbaston, Birmingham B15 3ES.
MY PET NEEDS FEEDING Please rush me a copy of your free 16 page catalogue of PET programs without obligation.

My name is

My PET lives at:

Lost for words? Perhaps your micro can help

One of the more talked-about uses for computers in both the home and office is for the production of letters and documents. However judging by the number of telephone inquiries we receive it appears that little is known about the commercially available software that runs on your own personal computer. We set out to find as many packages as possible that run on the common home machines, bearing in mind that these may also be used for business purposes.

What to expect for your money

It is very difficult to find a standard to judge software packages by so we devised a hybrid system, the basis of which is set out in Table 1. Using this as a guide we then compared the facilities provided by the various programs and these are given in the summary of each system. Without actually being able to run the programs, with the exception of the Connecticut package, it is impossible to give an indication of how easy to use they are. It is obviously a good idea to try a system out before actually commiting your money, no matter how good it looks on paper it might be difficult to operate.

It should also be borne in mind that these packages are processors, they virtually all need to have a previously prepared text file, this will require an Editor of some description and we have indicated in the product summary, Table 2, the available Editor.

Summary

Whilst this is by no means an exhaustive list of the available software it should at least provide a good starting point for further investigation and we will report in the future on any updates to the list.

Owing to the diversity of the packages it is impossible to say which is best, this decision can only be taken with respect to the type of application that you require.

A Hybrid Word Processor System

Functions	Description
Editing	The operator should be capable of last-minute corrections such as text insertion, deletion and moving text about.
Formatting	The final copy should be capable of appearing on any size of paper merely by changing the line and page parameters.
Presentation	The presentation of reports is enhanced by page numbering and headings. An ideal processor should be capable of centering text strings and also justification.

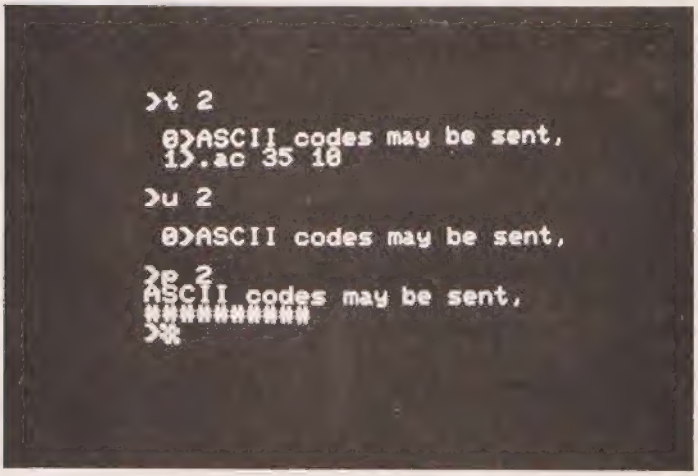
Note: these facilities are chosen as being the most commonly available and useful. A high-power WP system will undoubtedly provide much more, such as automatic indexing, footnotes and references.

Table 1.

Commodore PET

The well known Petsoft firm has produced a package called the Connecticut Word Processor Program. This system allows for either the generation of text or the useage of a previously prepared text file. It is possible to merge two or more files and then process them, allowing for the generation of standard forms and letters. The editing facilities allow for string interchange, line replacement and

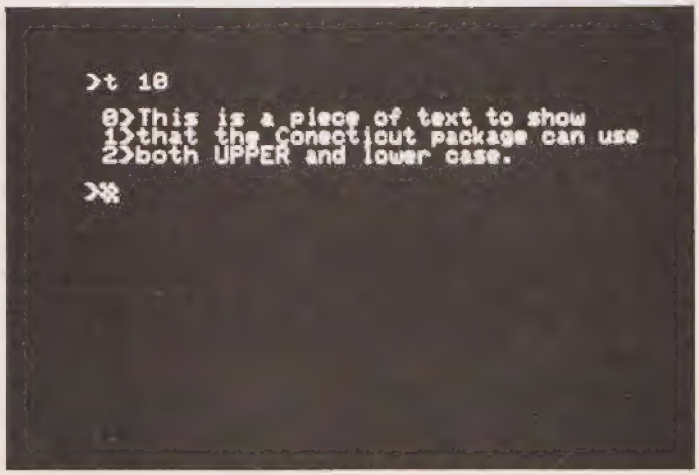
These photos show the Connecticut WPS in operation. The top photo shows the printing of an ASCII character by code, the second shows centering of a text string and the third photo shows the types of text that can be handled.



text insertion or deletion. The editing functions are carried out line by line using a locatable cursor.
Formatting allows for page and line length specification. The output device for this program is an RS232 printer connected via an adaptor, this allows for software control of the printer.
The presentation of the final document is limited to the use of centering and left-hand margin indent but several other facilities are available for use. It is possible to over-print lines, print a specific ASCII character, used for underlining etc., and repeat print a specified character string. Another feature is to stop the printout allowing for manual insertion of text at a specific point and then to continue printing. We have run this program, admittedly without a printer, and it appears to be easy to use and offer a reasonable command set.

Apple II

The software package for the Apple was supplied by Keen Computers and is simply known as the Word Processor. The program allows for the generation of text or the use of a previously generated file. Once a file is entered, you have to specify the length of the input file, it may be edited. The facilities available are text insertion and deletion, changeing of lines, string searching and replacement. The format of the final document is defined at the input stage and only allows for the width of paper. The final output is to a printer residing in slot 2 of the processor but by patching a statement in the program any interface slot may be used. The only presentation facility is the centering of text strings.



Nascom 1

The ICL/Dataskil Letter Writer program is supplied in two 2708 EPROM's and not only contains the processor but also the vital parts of the NASBUG monitor. This program

WORD PROCESSOR SUMMARY TABLE

MACHINE	Software	When Available	Supplier	Hardware Requirements	Cost
Apple II	Word Processor (text prepared on Text Editor)	Now	Keen Computers, 5 The Poultry, Nottingham. 0602-583254	Cassette or Diskette, printer in slot 2 but can be patched for other ports	£50 + V.A.T.
Commodore PET	Connecticut Word Processor (text prepared on MicroText Editor)	Soon	Petsoft, P.O. Box 9, Newbury. Berkshire. 0635-201131	Cassette + printer with RS232 adaptor, available from Petsoft.	£25 inc. V.A.T.
Nascom I	ICL/Dataskil Letter Writer	Now	Nascom Microcomputers, 121 High Street, Berkhampsted, Herts. 04427-74343	Cassette and printer	£70 + V.A.T.
SWT 6800	TSC Text Processor (text prepared using Editor)	Now	Southwest Technical, 38 Dover Street, London, W.1. 01-491 7507	10K, Cassette or Diskette, output to any port	
TRS 80	Word 1 Word 3 (text prepared using Text Editor)		A. J. Harding, 28 Collington Avenue, Bexhill-on-Sea, East Sussex. 0424-220391	Word 1 needs 12K and Level 2. Word 3 needs 16K, disk system. Both Tandy printers are suitable.	

Table 2. Summary table of available packages.

allows for the creation of text files as well as the editing of previous file stored on cassette. The editor functions are very powerful, allowing for the absolute positioning of the cursor within a line rather than simple line correction but string handling and text movement are not available. A tab function allows for the creation of tables or lists. It may be argued that as absolute cursor control is provided string handling is not absolutely necessary.

Text formatting is not available and it is up to the user to make sure that his document will fit on to the paper size, having done this once of course the document can be saved onto cassette and merely edited and re-used, an invoice for example.

The final presentation of the document must be defined by the user, no facilities are provided. Although this package may appear rather limited in its commands it must be remembered that this program fits into 2K of EPROM, the smallest program of any we have looked at in this survey.

SWT 6800

The TSC Text Processing System is a very powerful package indeed, disk based it requires at least 10K of memory and will output to any port. The program operates on a previously generated text file and does not allow for the editing of text, the SWT Editor should be used for this. The format commands allow for paper length and width, even to the extent of preparing a document to have suitable spaces for footnotes and headings on any subsequent page. The presentation

commands are extremely sophisticated, allowing for three types of justification, automatic page numbering, page heading and footnotes. There are many other features provided, text that is required in both upper and lower case on the final output may be prepared on an upper case terminal only, the text having 'format characters' inserted to indicate the letters required in upper case and the processor will automatically convert these before it outputs the text. Indentation of text is catered for as is multiple line spacing. A measure of the power of this system is that it is based on the NROFF text formatter which is widely used in the computer industry. No summary such as this can do justice to such a complex package and there are many more facilities besides those mentioned above, a complete article could be written on just this one program.

TRS 80

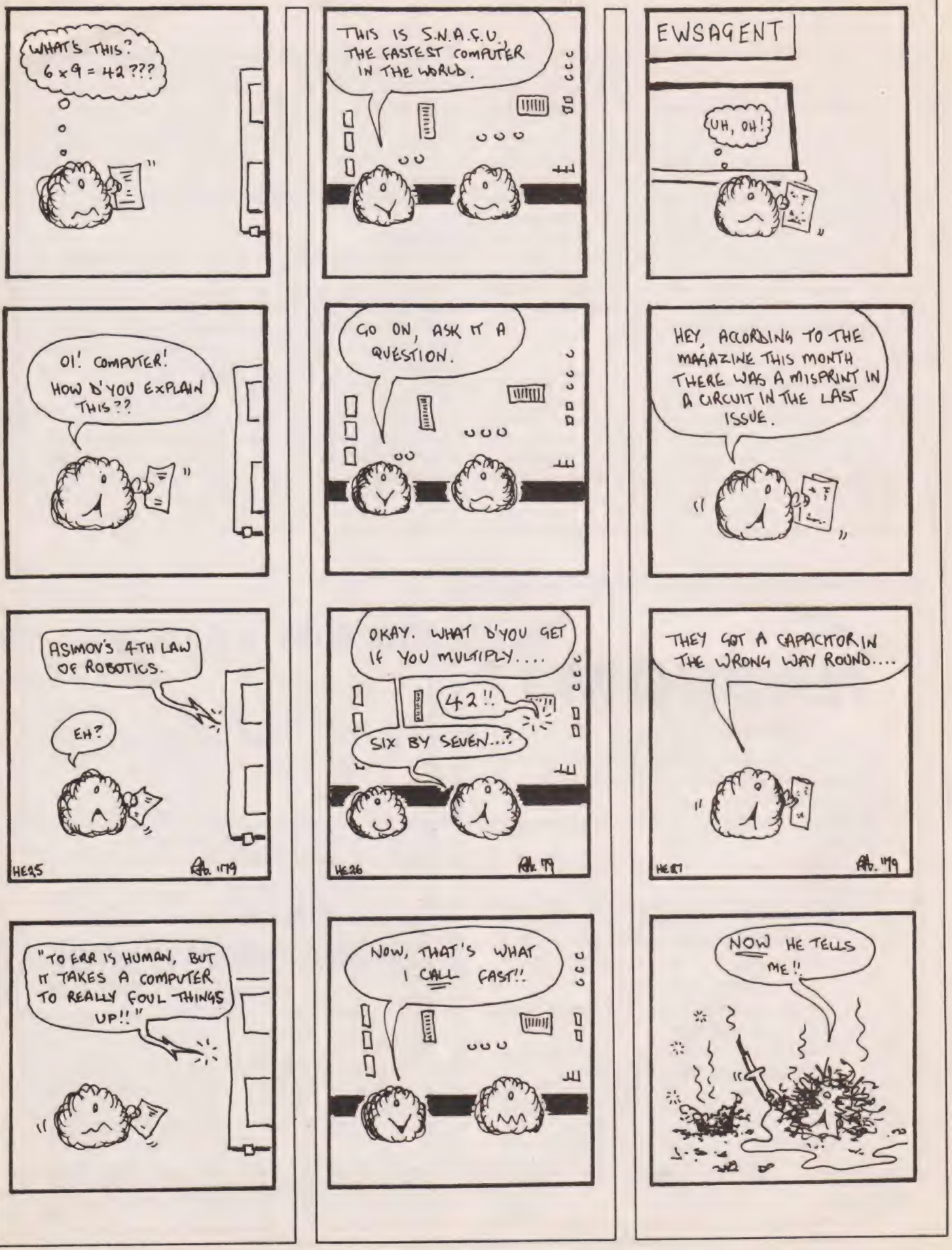
Two processor systems are available for the TRS 80 from A. J. Harding. These are Word 1 and Word 3. Word 1 runs on a level 2 system with a minimum of 12K memory and a cassette. Word 3 is diskette based and needs 16K and DOS. The packages are very similar and as such we will only comment on the differences. In general text editing is not supported, previously prepared files are used (a suitable text editor is available). Documents are formatted to page and line length with multiple line spacing available. The presentation commands cater for justification, centering, page numbering and heading and also a multiple column facility although this needs at least 16K and is not supported by Word 3, this is rather odd as this system is disk based! The packages also use the TRS 80 keyboard to enter commands rather than being software based, this does have an advantage in that it should make it easier to remember the controls as you use them all the time.

Summary

The most important part of any software package other than the fact that it will actually do the job is the provision of good documentation. Several of the packages we have reviewed are not yet available and their documentation has been written in America. The TRS 80 systems were pretty awful but A. J. Harding are going to completely re-write these before they are released, how our American friends ever coped is beyond me. The Apple is also rather poorly presented, with just over 3 A5 pages to tell you all about it. On the other hand the SWT Package is very thorough, and has been prepared using the actual processor. This shows the power available in the package as well as giving the necessary information. In the event of any further packages being available we would be most interested to hear of them, but please remember that good documentation is essential.

BEASTIES

Mr.R.Hill



apple II AT MICRODIGITAL

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BY BUYING THE BEST
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CASSETTE RECORDER TO MAKE A
POWERFUL, EASY TO USE COMPUTER SYSTEM

Apple II

Features

- A fast powerful integer BASIC is built into Apple II. The built-in assembler, disassembler and monitor will be appreciated by advance programmers in search of more speed or flexibility than BASIC can provide.
- Fifteen colour standard graphics in a 1,880 Point array for spectacular visual effects.
- High resolution graphics in a 54,000 point array for finely detailed display.
- Loudspeaker and sound capabilities that bring programs to life.
- Four hand control inputs for games and other human input applications.
- Internal memory capacity of 48K Bytes of RAM, 12K Bytes of ROM for big system performance in a small package.
- Eight expansion slots to plug in cards that give your Apple even more power.
- Superb, easy to follow documentation, so even a total beginner can use the machine.
- Fast (1500 baud) cassette interface.
- Proper typewriter style keyboard.

Apple II prices

With 16K of RAM

Nett.	Vat.	Total
985.00	78.80	1063.80

With 32K Bytes of RAM

1185.00	94.80	1279.80

With 48K Bytes of RAM

1305.00	104.40	1409.40

Applesoft II Floating Point BASIC

An expanded version of Microsoft's popular floating point BASIC. Its 9 digit arithmetic and large library make it ideal for business and scientific programs. Applesoft II is supplied either with a cassette tape or a plug in ROM card. The tape version is supplied free with every Apple.

Apple II ROM card

110.00	8.80	118.80

Floppy Disk Subsystem

Gives your system immediate access to large quantities of data. The subsystem consists of an intelligent interface card, a powerful Disk Operating System and one or two mini-floppy drives.

Features

- Storage capacity of 116 Kilobytes/diskette.
- Data transfer rate 156K Bits/second.
- Individual file write protection.
- Powered directly from Apple II.
- Full disk capability with systems as little as 16K bytes of RAM.
- Fast access time — 600 m sec (max) across 35 tracks.
- Powerful disk operating software.
- Load and store files by name.
- BASIC program chaining.
- Random or sequential file access.

Floppy disk subsystem

425.00	34.00	459.00

Second disk drive and connecting cable

375.00	30.00	405.00

Parallel Printer Interface Card

Allows you to connect almost any popular printer to your Apple. A BASIC program can produce hard copy output as easily as it prints to the TV monitor screen. Command interpretation and printer control details are handled by the firmware built into the card, to eliminate user programming requirements.

Parallel Printer Interface Card

Nett	Vat	Total
110.00	8.80	118.80

Communications Interface Card

Allows your Apple to "talk" (though a modem) with other computers and terminals over ordinary telephone lines. Now you can load programs over the phone, send messages to remote terminals or access your office computer from the comfort of your home.

Communication Interface Card

Nett	Vat	Total
110.00	8.80	118.80

High Speed Serial Interface Card

Allows Apple to exchange data with printers, plotters and computers in serial format at up to 19.2 K Baud.

High Speed Serial Interface Card

Nett	Vat	Total
110.00	8.80	118.80

Speechlab Voice Recognition Card

Allows the Apple to recognise a spoken vocabulary of up to 32 user selected words. The computer can be programmed to perform any task desired upon recognition of a key word.

Voice Recognition Card

Nett	Vat	Total
165.00	13.20	178.20

Prototyping Card

Provides the User with a means of building up experimental circuitry for the Apple computer. The 2¾" x 7" double-sided board includes a hole pattern that accepts all conventional integrated circuits and passive components. Documentation includes a complete system bus description to aid the interface designer.

Prototyping Card

Nett	Vat	Total
18.00	1.44	19.44

Carrying Case

The Apple is truly portable and this padded vinyl, leather look case protects your Apple in transit and makes it easier to carry.

Carrying Case

Nett	Vat	Total
25.00	2.00	27.00

accepted

Other Products

Apple maintains a 6 to 12 months technology lead over the competition. There is not sufficient space to give full details of all that is available, but the following is a sample to whet your appetite.

Light pen
Real time clock
Co-resident assembler on disk or tape
Programming aid ROM
Joysticks
PROM Burner

Apple Hire

The Apple is one of many machines from Microdigital (Hire) Ltd. For details ring Mike Maughan on 051-227 2535.

Software

We can supply application programs from a number of sources and advise you on your program requirements.

Our own software department has developed a Trade Counter program which keeps a round pounds debtors ledger in real time and advises trade counter staff when credit limits are reached.

This program is tried, tested and proven and helps reduce bad debts.

Nett	Vat	Total
25.00	2.00	27.00

Trade Counter Program (integer basic, needs 32K of RAM and a single disk)

NEWS FLASH

ITT 2020 SYSTEM

We are now dealers for the ITT version of the Apple at the following prices

	Nett	Vat	Total
With 4K Bytes of RAM	827.00	66.16	893.16
With 16K Bytes of RAM	950.00	76.00	1026.00
With 32K Bytes of RAM	1114.00	89.12	1203.12
With 48K Bytes of RAM	1278.00	102.24	1380.24

PART EXCHANGE

Pet owners, trade up to an Apple at MICRODIGITAL. We can allow up to £300 for your old PET against the cost of a new Apple II

MICRODIGITAL

To provide a better service
we have re-organised ourselves.
The following remain the same:—
Our shop is at
25 Brunswick Street, Liverpool.
Telephone order number
051-236 0707

The following are changed:—
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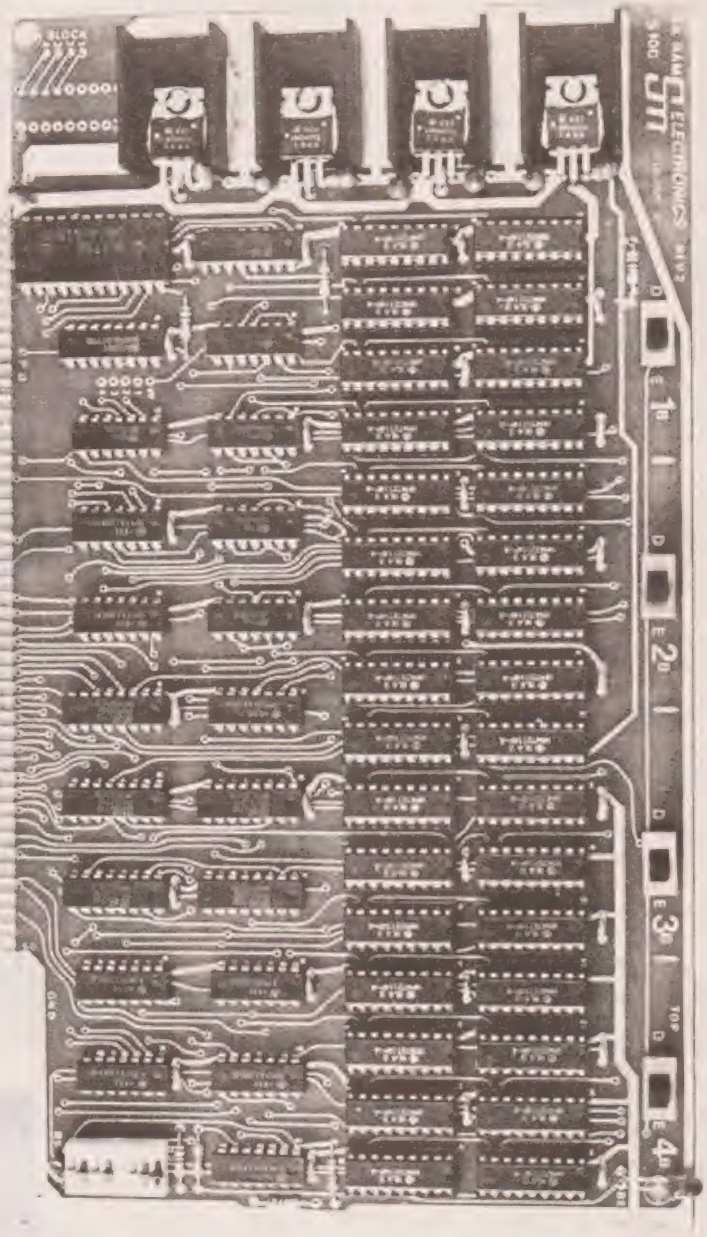
accounts, etc., are now at :—
14 Castle Street, Liverpool.
Telephone (except telephone orders)
051-227 2535/6/7.

Fully S-100 compatible 16K RAM card with some very impressive facilities.



Most of CT's microprocesseor-related projects are compatible with the S100 bus. Eventually we shall have a complete line of S100 cards so that readers may build up complete and powerful systems without having to scrap 'simpler' designs.

The majority of these projects are designed and developed by our own laboratory. We usually do it this way as we then have total control over design features and complexity and of course component choice. We like to think this is one of the major reasons why ETI projects are so popular.

Projects of this complexity involve massive investments in time, effort and money; it seems only fair that Mike receives some return for his work. So Mike is retaining the commercial rights to the printed circuit board. Individual readers who wish to make their own are perfectly free to do so however and may obtain the patterns free of charge (see below).

Description

The board carries up to 32 1K x 4 RAM chips. It is possible to use the HM472114P-3 which is more expensive but has a 300 ns access time. Another alternative is the pin-compatible Intel 2114 device which is cheaper but has the disadvantage of not having been 'burnt in' (i.e. run for a time) and then tested completely, as the Hitachi device has.

All of the above devices require only a single 5 volt supply and the board derives this from the 8 volt preregulated line of the S-100 bus.

The RAM is split into four 4K blocks, each of which can be placed anywhere in the 64K memory space of the system This is done by connecting each of four points on the board (one for each 4K

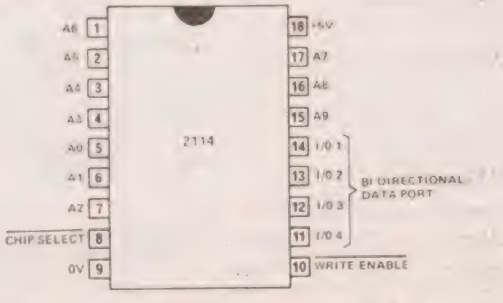


Fig 1 Pin–out of the 2114 1K by 4 RAM

block) to one of sixteen possible points which correspond to the possible positions in the 64K. If the board is not fully populated (i.e. if you couldn't afford all of the RAM at the one time and left one or more 4K blocks of sockets empty) then connecting one or more of the four 'block select' lines to +5V via a pull-up resistor will take care of that too.

The board also carries four 'write protect' switches which allow the user to create what is effectively ROM by preventing the system from writing to a particular block or blocks.

Wait States

For some systems the memory is slower than the processor that when a read or write occurs, the processor must be told to wait while the memory works. On some earlier systems this time delay was achieved by using a monostable – this entailed 'tweaking' the monostable period until the system worked! Instead, this board counts a selected number of clock cycles (up to 4), giving a fixed and predictable delay.

The card also carries hardware to implement the Cromemco 'bank select' system of memory management. Basically, this allows eight blocks up to 64 Kbytes in size to be enabled or disabled by setting the appropriate bit of output port 100Q (40H). A DIP switch on the lower right corner of the board enables the user to specify which bit of the control word the card will respond to. This scheme allows a processor with a sixteen-bit address bus to access up to 512 Kbytes with fairly simple software.

The card can be set to be either enabled or disabled on system reset, before the memory management software has set up the normal memory allocation. In most systems, one card will be enabled on reset and all others will be disabled to avoid bus contentions.

Phantom Line (Pin 67)

In some situations, users may want to locate a ROM containing say a monitor program at an address which conflicts with the RAM card. One way to do this is simply to remove the RAM card, or at least those chips which would conflict, but a better solution is offered with this card. If ROM must share an address with RAM, then the user should arrange for the ROM's address decoding logic to pull the $\overline{\text{PHANTOM}}$ line of the S100 bus low. This signal is applied to the address decoding logic of the RAM card and disables it if another device has priority. In this way the ROM can be made to 'occlude' part of the RAM. A link on the board selects this facility.

Construction

The experienced constructor who wants to save a few pounds can make up his own double-sided PCB, but as this will not be through-hole plated, the constructor will have to identify all the points where a track goes through the board and insert a link, unless there is a component lead at that point. We do not recommend this for the faint of heart (seriously). However, printed circiut patterns will be available, on receipt of a large stamped self-addressed envelope from Computing Today, S100 16K Foils, 25-27 Oxford Street, London W1R 1RF.

Remember also that the use of a non-through-hole plated PCB prevents the use of IC sockets, and especially beware of feedthroughs which must go under ICs, sockets or the DIP switch.

Construction should be fairly straightforward – the only choice that has to be made right at the start is how many IC sockets to use. There are three possibilities: none at all – this means that a dead IC has to be removed by de-soldering; RAM only – to enable 'swap testing' of these expensive devices and also easy replacement should they prove defective; all ICs socketed – IC sockets tend to be rather expensive and putting sockets on all ICs may not be cost-effective.

All the ICs fit in with pin 1 in the top left hand corner, so there shouldn't be any problem getting them the right way round. The only orientation-sensitive components are the LED (the flat on the side of the package goes to the right) and the tantalum capacitors.

Any IC sockets should be soldered in first, followed by the resistors and capacitors. The switches should be fitted next, followed by the regulators and heatsinks. At this point, power should be applied to the board and the outputs of the regulators measured – if they are anything other than +5 V, you've got a problem, and should check the power supply circuitry before inserting the ICs.

If everything checks out, the ICs should now be inserted and the options strapped. The board is now complete and ready for use.

PARTS LIST

Resistors all ½W, 5%
- R1, 2 . . . . . 2k2
- R3 . . . . . 1k
- R4–R6. . . . . 2k2
- R7 . . . . . 1k

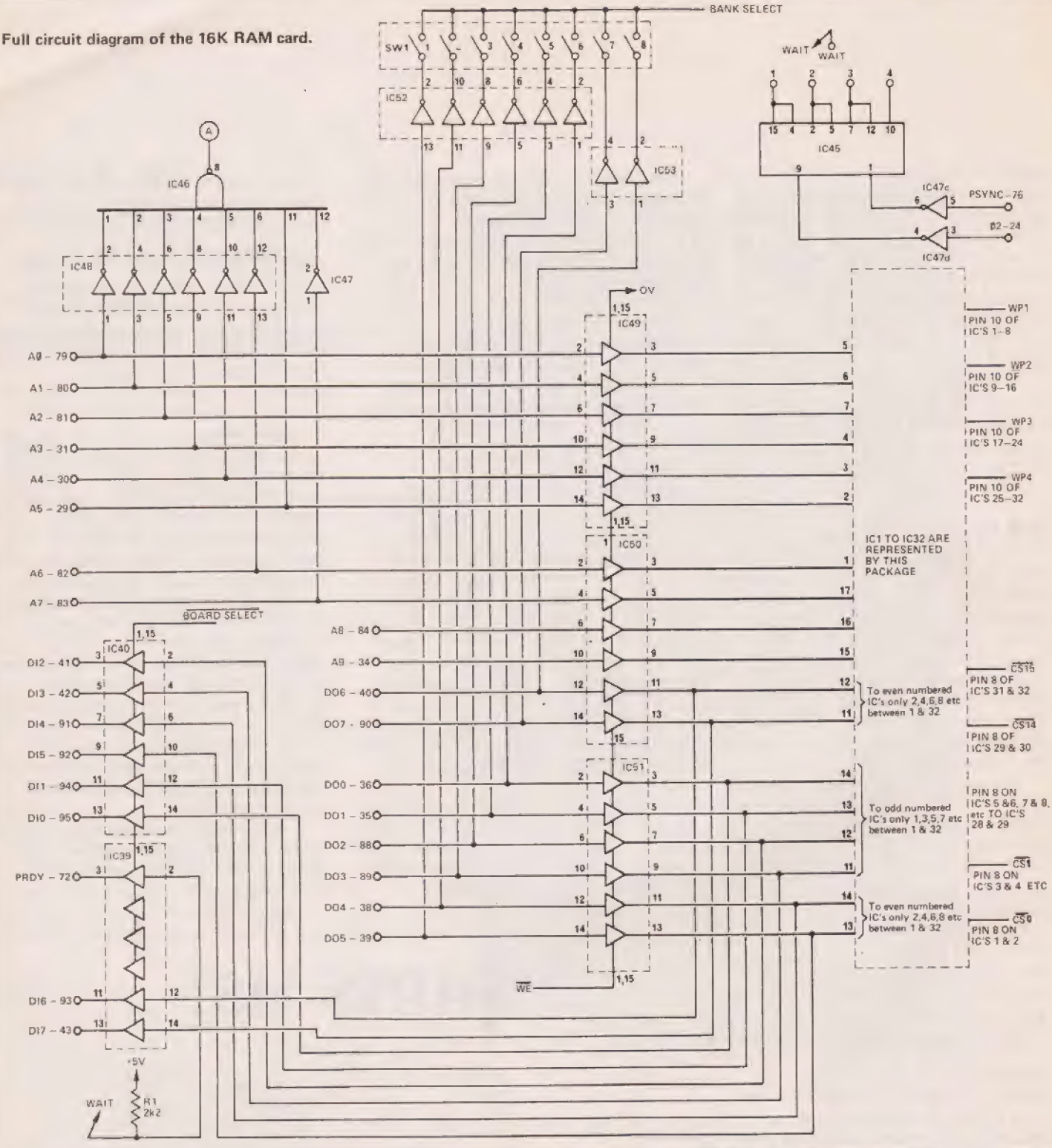
Capacitors
- C1–C8 . . . . . 10μ 25V tantalum
- C9–C36 . . . . . 10n ceramic

Semiconductors
- IC1–IC32 . . . . 2114 (see text)
- IC33 . . . . . 74LS138
- IC34–IC37 . . . 74LS32
- IC38 . . . . . 74LS20
- IC39, 40 . . . . . 74LS367
- IC41 . . . . . 74LS10
- IC42 . . . . . 74LS04
- IC43 . . . . . 74LS74
- IC44 . . . . . 74LS154
- IC45 . . . . . 74LS175
- IC46 . . . . . 74LS30
- IC47, 48 . . . . . 74LS04
- IC49–IC51 . . . 74LS367
- IC52, 53 . . . . . 74LS05
- IC54–IC57 . . . LM340T5

- LED 1 . . . . . Red LED

Miscellaneous
- pcb ETI 642
- Four single-pole two-way slide switches
- One eight-pole one-way DIL switch
- Four heatsinks to suit regulators

Full circuit diagram of the 16K RAM card.



HOW IT WORKS

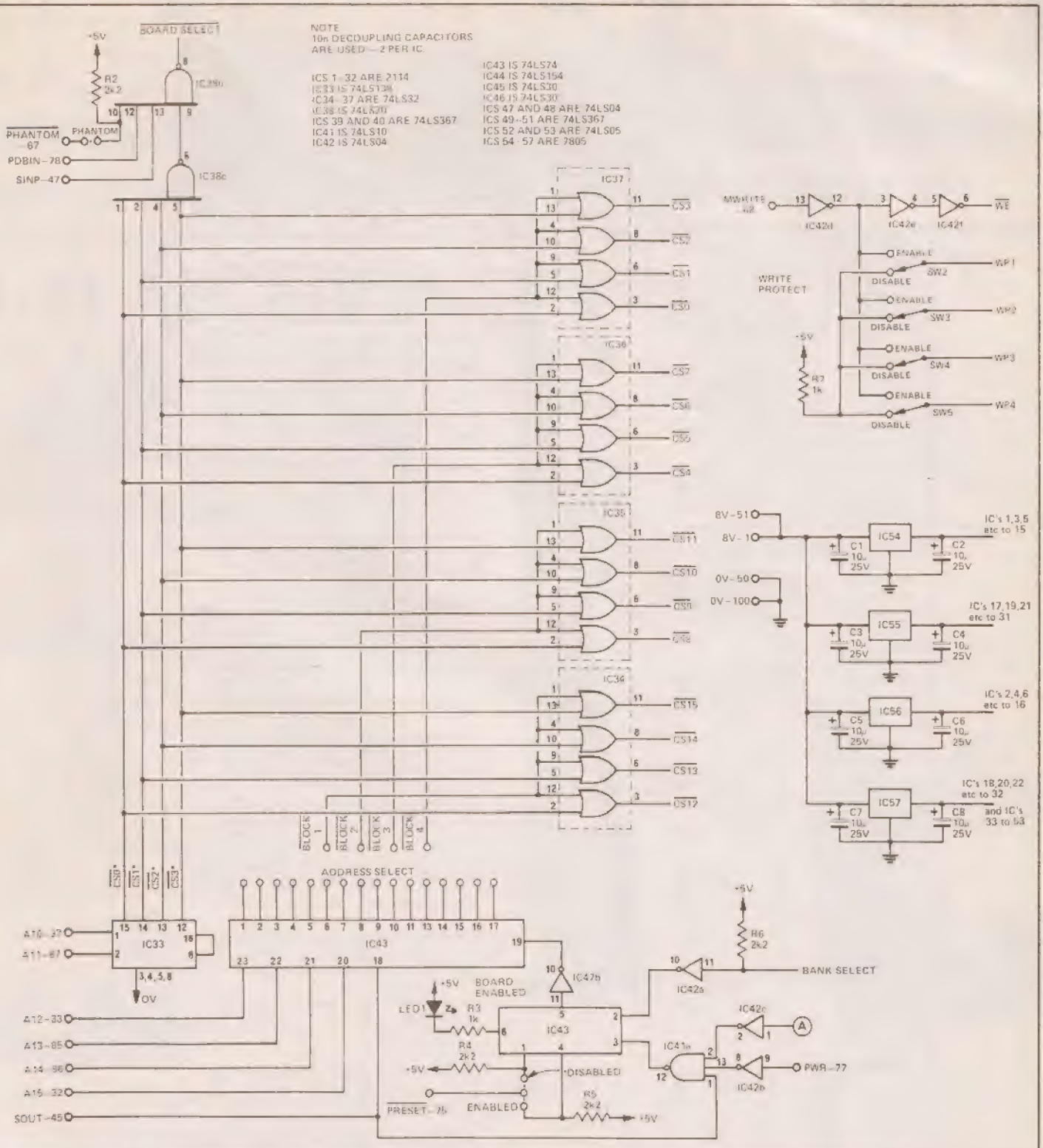
The address and data lines are tri-state buffered by ICs 39, 40, 49, 50 and 51 (74LS367). This means that the buffers have three possible output states – '1', '0' and high impedance (effectively disconnected).

The address lines to the RAMs are always active (i.e. not tri-state) – pins 1 and 15 of IC49 and pin 1 of IC50 are earthed to permanently enable the buffers. The data in (to the processor) and data out (of the processor) lines are connected to the same points on the RAMs and so the data out (of the processor) lines have to be tri-stated while the processor is reading. This is done by the $\overline{WE}$ line, which feeds the tri-state control input of IC51 and part of IC50.

This same $\overline{WE}$ signal is also fed via the four 'write protect' switches to the 'not write enable' inputs of the RAMs. Each of these controls one 4K block while these switches are in the 'disabled' position the ram contents will not change.

The high-order bits of the address bus are decoded by IC44, which is simply a 4 to 16 line decoder. The outputs of this IC are then wire-linked to the 'not block select' lines 1 to 4 to determine where each of the four 4K blocks is to reside in memory.

Bits 10 and 11 of the address are



decoded by IC33, a 2 to 4 line decoder which determines which pair of chips is being accessed out of the 4K block (a pair of chips constitutes 1K of RAM). This is combined with the 'block select' signals in ICs 34 to 37 to form the 'chip select' lines 1 to 16 which go to the RAM chips.

IC45 simply counts clock cycles (the S100 Ø2 signal) until the wait period is over. The number of cycles is determined by a wire link to one of the outputs of the IC and the counter is reset by the S100 PSYNC signal. A pull-up resistor selects 0 wait states if no link is present.

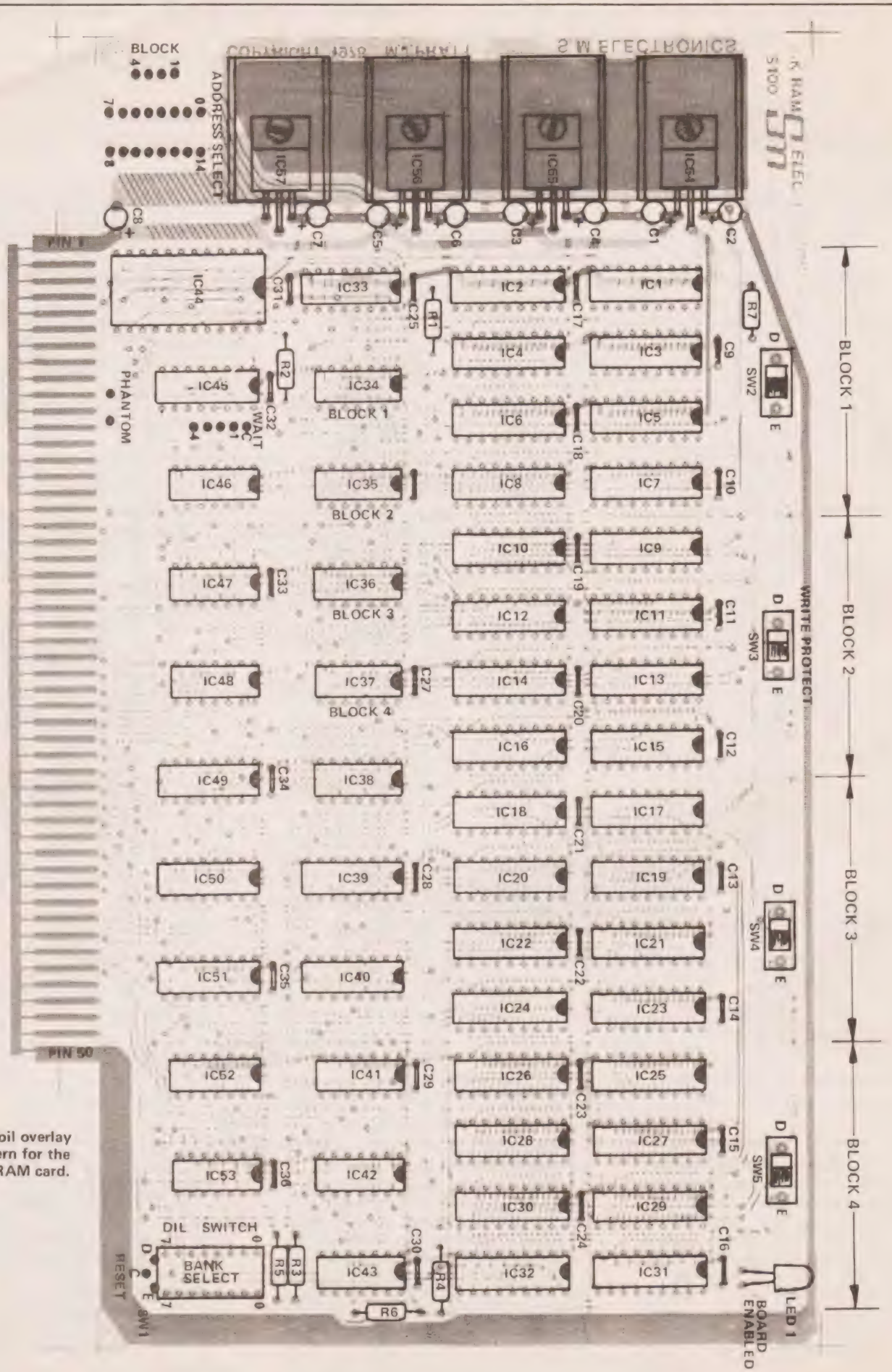
The cromemco 'bank select' hardware toggles flip-flop IC43. One output from this enables the outputs of IC44 while another drives the 'board enabled' LED.

An attempt to output to the 'bank select' port at 100 octal (hex 40) is detected by the address decoder, ICs 46 and 48 and part of 47. Detection of the right address, $\overline{PWR}$ ans SOUT signals causes IC43 to accept any signal which makes it through SW1, the bank select switch. This is fed from the data bus and effectively selects which of the eight possible 64K blocks the board will 'appear' in.

The $\overline{PRESET}$ line of the bus is connected via a wire link to IC43 and the position of the link determines whether the board is enabled or disabled on processor reset.

Lastly, the $\overline{PHANTOM}$ facility can be used by completing the link from line 67 of the bus to pin 10 of IC38. This will disable the board if the $\overline{PHANTOM}$ line is pulled low.

16K RAM CARD



PCB foil overlay pattern for the 16K RAM card.

electronics today international

What to look for in the June issue: On sale May 4th

HI-FI RECEIVER

A fifty watt stereo amplifier and a high quality tuner would make two excellent projects in themselves. With specifications such as these boast, we could be sure that the units would soon become widely accepted as the very best in DIY hi-fi. However we've gone one better to combine the two units to produce a receiver of outstanding merit. If you're about to buy, build or borrow a high-class hi-fi — stop it at once until you've read next months ETI.

ANYBODY THERE?

That intelligent life exists elsewhere in the Universe is a mathematical certainty. Whether or not it rides around in flying saucers we cannot afford to ignore the fact that it is there — somewhere. Steps are being taken to communicate with other worlds by some of this planet's largest observatories, and they may surprise you. Don't blame us if after close reading of this, you encounter more than lights in the sky!

READERS' DESIGNS

Next month's is a remote controlled light dimmer which uses an ingenious voltage control circuit and ultrasonic transmiss technique. Can be adapted to give remo level control of just about anything.

ECM

ECM (Electronic Counter Measures). Without extensive capability in this field a modern fighter aircraft stands about as much chance against its opponents as would a bi-plane. Radar homing missiles can be jammed, locating radar foiled and laser targeting pick out a plane for ground-to-air attack in a fraction of a second. On the ground too, anti-tank missiles, remotely guided, can "take out" highly sophisticated (and expensive) tanks before they get time to retaliate. The principle behind the machinery are fascinating and their implications chilling. Read about them next month in our comprehensive article.

Mr. P. Cornes

This month we examine an ancient game

I can well imagine that last month's homework might have given one or two of you quite a headache if you attempted it seriously. If it did, don't worry, because we shall be going into this problem in some depth as it forms a crucial part of the game program that we are going to develop.

NIM

Many of you will already have played this game, indeed some of you may well be up to grand master standard. Nim is played with piles of matches. Two players take it in turn to remove matches from the piles until one of them takes the last match and is declared the winner. The computer versions of this game can have anything from 3 to 6 piles with from 1 to 7 matches in each pile. The rule by which the players remove matches is as follows. Each player can remove as many matches as he likes on his turn, but from only one of the piles. For example, if a game were to begin with 3 piles each containing 7 matches, the first player's move would consist of choosing one of these piles and removing from it anything between one match and the whole pile. This rule applies right down to the end of the game, so that if at the end a single pile remains containing 3 matches the person whose turn it is to play can remove the whole pile and by doing so he also takes the last match to win. Though it has but a single rule, this game can be surprisingly subtle as you may well soon see.

Last Weeks' Answer

Before we delve into the game proper, a sample answer to last month's homework could be as follows.

```
6014 INPUT Q
6015 RESTORE
6020 FOR T = 0 TO Q
6030 READ V,B,M
6040 NEXT T
6041 PRINT V, B, M
6042 GOTO 6014
7000  DATA  0,0,0,0,0,1,0,1,0,0,1,1,1,0,0,1,0,1,1,1,0,1,1,1
```

If you look at the program listing for NIM below, you will find that lines 6015, 6020, 6030, 6040 and 7000 are more or less the same as those given in the homework answer above, so you can see that the idea of converting decimal to binary is used in this program. The way that the above program segment works is as follows:-

Line 6014 takes the value to be converted and assigns it to the variable Q. Line 6015 does nothing the first time it is executed, but we shall see why it is included later. Line 6020 sets up a FOR NEXT loop which will be executed the same number of times as the value of Q that was INPUT earlier. Line 6030 forms the contents of the FOR NEXT loop and what this does is to READ values for V, B and M from the DATA statement in line 7000. You should see, if you examine the DATA statement, that when we reach line 6040, V, B and M have been set to the binary equivalent of the current value of T. We will go round the FOR NEXT loop until T equals the value of Q input in line 6014, by which time V, B and M will be set to the binary equivalent of the value of Q. Line 6041 prints the values of V, B and M that have just been "looked up" and line 6042 returns control to line 6014 to ask for another number to be converted. You should now be able to see why line 6015 has been included, because it now RESTORES the data pointer back to the beginning so that we can READ from the start of the DATA list again for the second and subsequent values of Q. I can hear you protesting that I have cheated by using this method of conversion, and I admit that it is not very efficient if there are large numbers to be converted, as the DATA statements would soon grow unwieldy. However, as the maximum number to be converted is 7, this method works quite well.

This Months Exercise

The operation and flow chart of the program listed below will not be presented until next month, because the computer uses a very precise mathematical method for calculating its moves, and if we were to go into the method now, there would be no point in playing the game as the outcome could be determined with certainty before the game was actually started. So all that will be presented this month is a full program listing which should be more or less self-explanatory in its use (see Fig. 1). The program has been written in as general a fashion as possible. However, one or two changes may be necessary as you type the program into your machines, because of the slightly differing facilities offered by various machines.

The Nim Program

The first thing to note is that the listing of Fig. 1 is a program complete in itself. However, the program as presented in Fig. 1 does not give instructions on how to play the game, nor does it check the validity of the various inputs that you will be required to make during the playing of the game. It is presented in this way so as to reduce its program memory requirement, but if you find that you have sufficient memory space available on your mchine, you can also add the program lines listed as Fig. 2 which make the program more complete by giving instructions and making the aforementioned checks.

The next thing which might need changing is the use of the single subscript variable A[X]. The square brackets may be unnacceptable to some machines, in which case they should be changed to the more conventional round brackets. Also, on some of the tiny BASIC machines, the only single subscript variable available is the @ array, so you will need to substitute this for the A array used in Fig. 1. Another problem may occur on tiny BASIC machines with statements like those in lines 150,

```
5  GOSUB 9000
42  IF A<3 THEN 30
44  IF A>6 THEN 30
46  A=INT(A)
82  IF A(X)<1 THEN 70
84  IF A(X)>7 THEN 70
86  A(X)=INT(A(X))
2012  IF R<1 THEN 2000
2014  IF R>A THEN 2000
2016  R=INT(R)
2018  IF A(R)=0 THEN 2000
2032  IF R<1 THEN 2020
2034  IF R>A(R) THEN 2220
2036  R=INT(R)
9000  PRINT "DO YOU WANT INSTRUCTIONS (1=YES 0=NO)"
9010  INPUT D
9020  IF D=0 THEN 9200
9030  PRINT "THIS IS NIM"
9050  PRINT "THE GAME IS PLAYED BETWEEN ME AND YOU. WE PLAY WITH"
9060  PRINT "PILES OF MATCHES (BETWEEN 3 AND 6 PILES WITH UP TO"
9070  PRINT "7 MATCHES IN EACH PILE. THE OBJECT OF THE GAME IS "
9080  PRINT "TO TAKE THE LAST MATCH TO WIN."
9090  PRINT "THE RULE BY WHICH MATCHES ARE REMOVED FROM THE PILES"
9100  PRINT "IS AS FOLLOWS:"
9110  PRINT "WE TAKE IT IN TURNS TO MOVE AND ON EACH TURN YOU CAN"
9120  PRINT "TAKE AS MANY MATCHES AS YOU LIKE, BUT FROM ONLY ONE "
9130  PRINT "PILE IN ANY ONE MOVE."
9140  PRINT "WHEN WE START YOU WILL HAVE THE OPTION OF EITHER "
9150  PRINT "SETTING THE BOARD UP YOURSELF OR LETTING ME DO IT."
9160  PRINT "I WARN YOU, I AM GOOD AND SO TO GIVE YOU A CHANCE"
9170  PRINT "YOU ALSO GET THE OPTION OF WHETHER TO START FIRST"
9180  PRINT "OR NOT. I HOPE YOU ENJOY THIS GAME, AND HERE IS"
9190  PRINT "YOUR CHANCE TO FIND OUT."
9200  RETURN
9999  END
```

The listing for the game instructions

156, 250, etc., which are used to generate random numbers, as there is no INT function needed on an integer-only computer.

For example, line 150 could be changed to:-

150 A = RND(4) + 2

For those of you who do not remember, there are two different types of RND function, one of which uses RND(0) to generate a four- or five-digit decimal number between 0 and 1 which then has to be converted by multiplications, additions and the use of the INT function to bring it within the desired range of random numbers. The other type of RND function is RND(X) — available on most common mini—BASIC languages— which generates a random integer between 1 and X. So the new line 150 above generates an integer between 1 and 4 and then adds 2 to bring it within the range 3 to 6. This is then assigned to A. Line 150 in Fig.1 performs the same function, but operates in the following manner.

RND(0) is evaluated first, and generates a number in the range 0.00000 to 0.99999. This this is then multiplied by 4 to give a number in the range 0.00000 to 3.99996. One is then added to this to give a range 1.00000 to 4.99996. The INT function is then applied to this value, which removes the decimal portion of the number to leave an integer between 1 and 4 (as in RND(4) above) and once again we add 2 to give a final range of 3 to 6 to be assigned to A.

Some machines may need the semi-colons in line 300 changing to commas.

The last point concerns the lines 6080 to 6100. The symbol " # " used in these lines means "is not equal to" and may need replacing with on some machines. Also, if you have an integer-only machine, you will need to replace these three lines as follows.

6080 IF Z<>Z/2*2 THEN 6120

```
10  PRINT "DO YOU WISH TO SET UP THE GAME"
11  PRINT "(1=YES 0=NO)"
12  INPUT A
15  F=0
14  R=0
17  P=1
18  D=0
20  IF A=0 THEN 150
30  PRINT "HOW MANY PILES DO YOU WANT (BETWEEN 3 & 6)"
40  INPUT A
50  PRINT "HOW MANY MATCHES IN PILE (BETWEEN 1 & 7)"
60  FOR X=1 TO A
70  PRINT X,
80  INPUT A(X)
90  NEXT X
100  GOSUB 6000
110  GOTO 170
151  A=INT(RND(0)*4+1)+2
153  FOR X=1 TO A
154  A(X)=INT(RND(0)*7+1)
160  NEXT X
163  GOSUB 6000
170  PRINT "DO YOU WISH TO START FIRST (1=YES 0=NO)"
175  INPUT S
190  IF S=1 THEN 2000
194  D=0
200  FOR P=1 TO A
205  IF A(P)=0 THEN 245
210  FOR R=1 TO A(P)
220  GOSUB 6000
221  IF D=1 THEN 300
240  NEXT R
245  NEXT P
250  R=INT(RND(0)*A+1)
255  IF A(P)=0 THEN 250
260  R=INT(RND(0)*A(P)+1)
265  PRINT "I'LL TAKE";R;"FROM PILE";P
285  A(P)=A(P)-R
287  GOSUB 5000
300  IF F=0 THEN 2000
350  PRINT "I WIN......."
360  GOTO 3000
2000  PRINT "WHICH PILE DO YOU WISH TO TAKE FROM"
2010  INPUT P
2020  PRINT "HOW MANY TO BE TAKEN"
2030  INPUT R
2035  A(P)=A(P)-R
2040  GOSUB 5000
2050  IF F=0 THEN 193
2060  PRINT "YOU WIN....."
3000  PRINT "DO YOU WISH TO PLAY AGAIN"
3001  PRINT "(0=NO 1=YES)"
3010  INPUT S
3020  IF S=1 THEN 10
3030  END
5000  Z=0
5010  PRINT "PILE NO.","NO. OF MATCHES"
5020  FOR Q=1 TO A
5030  PRINT Q,A(Q)
5040  IF A(Q)=0 THEN 5050
5045  Z=1
5050  NEXT Q
5051  PRINT
5052  PRINT
5060  IF Z=1 THEN 5080
5070  F=1
5080  RETURN
6000  A(P)=A(P)-R
6002  Z=0
6004  U=0
6006  I=0
6010  FOR Q=1 TO A
6012  IF A(Q)=0 THEN 6060
6015  RESTORE
6020  FOR T=1 TO A(Q)
6030  READ U,B,M
6040  NEXT T
6045  Z=Z+U
6050  U=U+B
6055  I=I+M
6060  NEXT Q
6070  A(P)=A(P)+R
6080  IF Z#INT(Z/2)*2 THEN 6120
6090  IF U#INT(U/2)*2 THEN 6120
6100  IF I#INT(I/2)*2 THEN 6120
6110  D=1
6120  RETURN
7000  DATA 0,0,1,0,1,0,0,1,1,1,0,0,1,0,1,1,1,0,1,1,1
9999  END
```

The complete NIM game program

and the same for 6090 and 6100 with the variables U and I. I hope you enjoy playing this game, and we will come back to look at it in more detail next month.

This month's homework is to play the game and become familiar with it if you can and try to draw a flow chart and analyse how it works.

PRINTOUT

Dear Sir,

With reference to the April edition of Computing Today; I found the NASCOM Package Program most interesting, but was astonished to see such a high incidence of mis-spelt words. Page 16 contains a glaring example– the word separate is mis-spelt four times in such a small paragraph.

When one considers that your magazine is now widely read in schools and colleges it should set a good example. Surely work submitted for publication is vetted by the Editorial Staff - or is it?

Now that I have raised my criticism may I say how much I enjoy reading Computing Today and your sister magazine E.T.I.

Yours sincerely,
W.M.Davies.

98 Henley Road,
Cheltenham,
Glos.GL51 0LD

Dear Sir,

Congratulations on an excellent magazine. I have just read the April issue, and I shall most certainly be a regular reader. However, I would like to echo Derek Anderson's point about the quality of the photographs in your magazine – i.e. in the "Nascom Package" feature the photos are totally out of focus/overexposed and unintelligible; also in the WCE show report, the photos are nothing short of attrocious! The bad reproductions seem to manifest themselves also in your parent magazine ETI.

However, the overall content of the magazine is excellent, ie. aimed at the likes of myself whose HOBBY is computing, and having the restrictions of a tight budget.

Yours sincerely
Marek Kuczynski

64 Station Road,
Kings Heath,
Birmingham,
B14 7SR

Dear Sir,

With reference to April's Nascom Package. I have found two faults with the program, one is obviously a printing error,

```
F6D  13   A3   E , A3   should be
F6D  1E   A3   E , A3
```

The other problem is more subtle,

```
EE7  3E   FA   A , FA   should be changed to
EE7  3E   00   A , 00
```

If this is not done then errors occur if your balance runs into the 'red', for example – if register A is loaded with FA then the following will occur:–

DEBIT	BALANCE
	0.00
1.00	–0.94

whereas if A is loaded with 00 then the correct result is calculated.

Now a word of warning to all who are thinking of buying a Nascom 1 kit. I have not met anybody who has managed to construct one of these kits and get it to work the first time. A common fault is shorting between tracks on the printed circuit board (bad etching), other problems can occur due to poor quality of components (I had two dud memory chips). The tape interface is not really suitable, I have had to change mine to a more reliable one (Cottis Blandford Cassette Interface). Also, in my case, the copper tracks on the printed circuit board for the keyboard break quite regularly, this is because they take some of the pounding given to the keys. Whilst this type of problem is easily rectified it is very annoying and if you do repair your own keyboard then the warranty is invalidated. Hence the warning -- even if you do everything correctly it doesn't mean that it will work. If you have no experience n building kits or fault finding in digital circuits then think about buying a working model.

Another annoying fact with Nascom products is the long time one has to wait for the delivery of goods, months rather than weeks. How many people ordered a Nascom 8A power supply in September 1978 and are still waiting (the power supply was advertised in ETI, October edition)? Nascom have no intentions in delivering this supply until late April (1979 I hope).

At present I am waiting for a 8A power supply, mother board and 8K memory. In the future I want to update to 64K memory with a high level language using DOS, but this will not be for some time yet (how do you think I found fault with the Balance Program?).

How about a review of the 8K BASIC available for the Nascom 1, I haven't heard anything about it as yet (except that it exists).

Yours faithfully,
A.R. Ingleson, B.Tech.
27 Cecil Avenue,
Great Horton,
BRADFORD,
West Yorkshire.
BD7 3BW

P.S. Keep up the good work, lets hope you maintain the standards set by E.T.I.

CT MARK

CLOCK RADIO

You probably won't believe us as we're selling the goods but we're going to tell you anyway! We have *rejected* eight clock radios for Marketplace: they were all cheap enough but the quality was so poor that we couldn't have lent our name to them. However, we are now able to offer a portable LCD Clock Radio to you which meets our standards.

The clock is a 12-hour one with AM/PM indicated and a back light. The radio is Medium Wave and FM with very nice quality for a small speaker — for FM there's a telescopic aerial. The alarm can be either a 'beep-beep' type or the radio, there's also a snooze facility.

The case is sensibly rugged and is printed on the back with a World Time Zones map, a bit of a cheek really, especially as the time is relative to Japan!

We won't even mention the RRP — but just check on comparable prices — you'll find ours a bargain.

An example of this Clock Radio can be seen and examined at our Oxford Street offices.

£20.50

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Name .....

Address .....

Please allow 28 days for delivery.

LADIES LCD WATCH

. . . and don't you ever say we don't listen to you again! Ever since we first did a gentleman's watch, we have been dealing with a constant never-ending stream of requests for a ladies' model. Well at long last we can claim to have done something about it!

It wasn't easy arranging this sort of price on a product this good — but ETI's done it again! The watch is small enough to look good on the prettiest wrist, and accurate enough to satisfy the most fastidious. Normal display shows time of course, with both date and seconds available on a push of a button. A backlight is also included.

Battery life should be greatly in excess of a year, and the bracelet is a smart stainless steel.

An example of this watch can be seen and examined at our Oxford Street offices.

£9.95

(Inclusive of VAT and Postage)

To:
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ET Magazine
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London W1R 1RF

Please find enclosed my cheque/PO for £9.95 (made payable to ET Magazine) for a ladies LCD watch.

Name .....

Address .....

Please allow 28 days for delivery.

DIGITAL ALARM

THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

A example of this clock can be seen and examined at our Oxford Street offices.

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London W1R 1RF

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Name .....

Address .....

Please allow 28 days for delivery.

ETPLACE

LCD CHRONO

We feel we've got to tell you carefully about this offer which we're introducing for the first time. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The exact same watch is currently being offered by another magazine as a special at £24.95 — some of the discounters are selling it at £29.95. the price to ET readers for exactly the same watch is £12.95.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a couple of seconds and you have a highly accurate stopwatch with hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed.

A sample of this watch can be seen and examined at our Oxford Street offices.

£12.95

(Inclusive of VAT and Postage)

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ET Magazine
25-27 Oxford Street
London W1R 1RF

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Name

Address

Please allow 28 days for delivery

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Both ETI and Hobby Electronics have sold a lot of digital alarm clocks — over 10,000 in fact — maybe that's something to do with the fact that we sell at real bargain prices. Now we can offer you a truly modern, space age model.

It includes all the facilities expected in a good design — fast, slow setting, snooze facility, etc plus two unusual features — automatic brightness control and a weekend alarm cancel.

An example of this clock can be seen and examined at our Oxford Street offices.

£10.50

(Inclusive of VAT and Postage)

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25-27 Oxford Street,
London W1R 1RF.

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Name

Address

Please allow 28 days for delivery

ALARM-CHRONO LCD

Currently this watch is being discounted elsewhere for typically £39.95 (we don't quote RRP as this is meaningless) and the watch is a 'Chinese copy' of a very famous one in the £100 range!

The facilities are exceptional

- Normal hours and minutes
- Continuous seconds or data display
- Day of the week
- Stopwatch with 0.1 secs resolution
- Lap time facility with automatic return to stopwatch after 6 seconds
- Different time zone setting with independent date, day of week settings
- Good bleeping alarm
- Easy time correcting: on the sixth 'pip', press a button and it's reset to 00 seconds as long as watch is plus or minus 29 seconds

It comes with a full guarantee of course

An example of this watch can be seen and examined at our Oxford Street offices.

£27.95

(Inclusive of VAT and Postage)

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ET Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please find enclosed my cheque/PO for £27.95 (payable to ET Magazine) for my Alarm/Chrono LCD watch.

Name

Address

Please allow up to 28 days for delivery

Mr. M. Bell

Nifty ditties from a mini–micro

Bach, Beethoven, Bacharac or the Beatles. What ever your taste of music it is now almost essential to your way of life. Music's origins date back as far as records (no pun intended) can go. Is there anyone who doesn't own or have access to a radio, record-player, TV or musical instrument. It is therefore not unreasonable that the budding programmer with a personal computer should not desire it to 'sing'.

Hardware

The hardware necessary for a monophonic output is very simple. All that is needed is a 'buffer' on an output port to ensure that the port is not overloaded, and a single stage transistor amplifier capable of driving a loadspeaker. Should one wish to couple a power amp via a preamp this should be done from a series resistor directly off the buffer output. The components shown are not critical with the exception of R1. This can be as low as 40 ohms, where its dissipation will be 25 W but I have found that 430 ohms gives adequate volume and does not drain the supply appreciably. The input of this circuit should be connected to SKT 1 Pin 14 (ie PORT O BIT 5). See fig. 1.

Software

The software side of the story is somewhat more subtle. The main programme should be as small as possible to give maximum data space, and the data should be compact so as to require as little room as possible. It was therefore decided to make all control characters on a 'latch' principle requiring one byte, and all note information (pitch & value) another byte. Thus if a piece was to be played within a single octave only one control character need be used.

Documentation of Music

The documentation of music and the art of programming are incredably similar. For example, music whether classical or pop has FORM. A primary theme may be repeated and followed by a secondary theme which is then also repeated, like the Handel piece shown. Or there may be a chorus as with folk music. Take the classical rondo form A-B-A,C,A-B-A,A. It is easy to see that the primary theme 'A' is a subroutine, 'B' has a single repeat

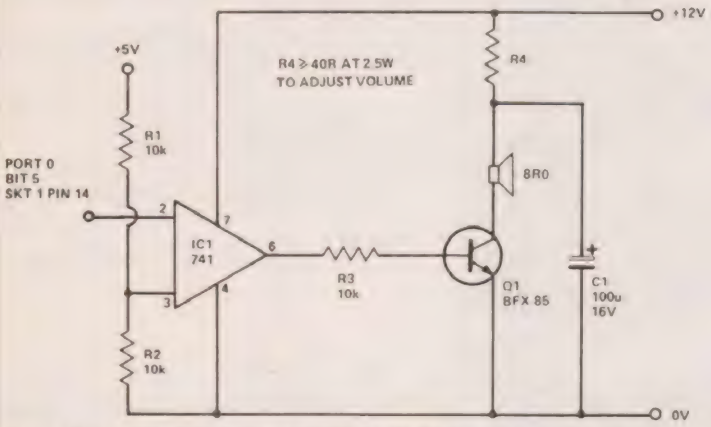


Fig. 1 The amplifier circuit for the NASCOM tune generator

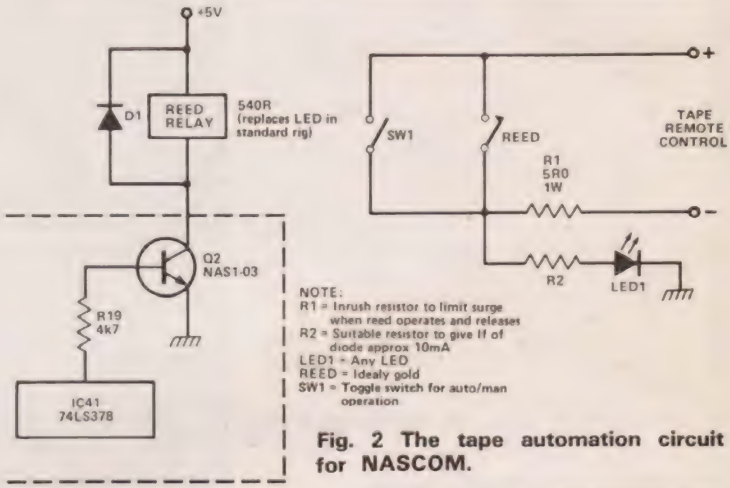


Fig. 2 The tape automation circuit for NASCOM.

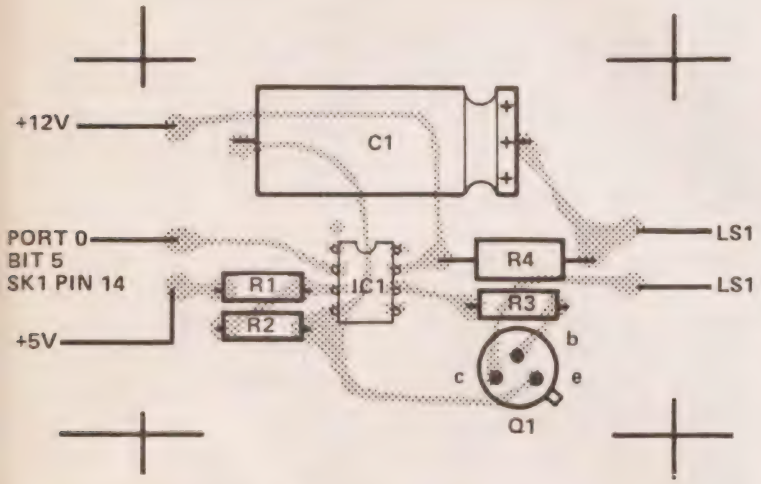
HOW IT WORKS

The program can be divided into two sections; that dealing with control and that dealing with note value and pitch. The note section is built around a clock of approximately 18uSec between repetition. By decrementing count registers, E in the case of value and C in the case of pitch, the appropriate timings can be achieved.

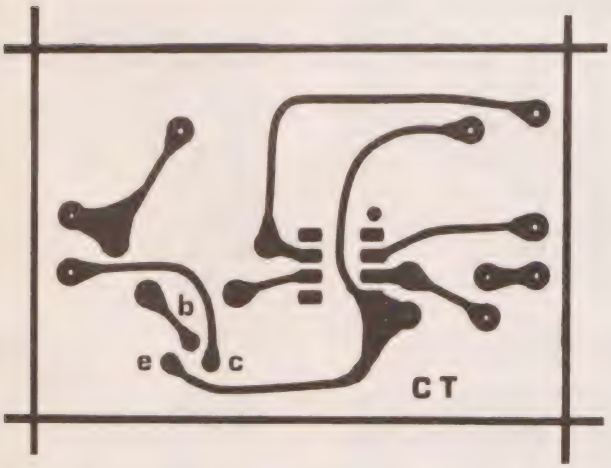
The note pitch and value is obtained from a single byte as follows: If the byte is 'xy' then the most significant 4 bits 'x' provides a pointer to the value in the look up table 'T1'. This table gives the interval register value. Similarly the least significant 4 bits 'y' provides a pointer in the look up table 'T2' from where the note pitch register value is obtained. You will note that when 'y' = 0 a rest is played.

As the max coded value is ED, all byte codes of higher value than this can be used for control. If the Control Code Table is looked at it will be seen that there are 18 codes. Four which set the octave, (F2 x4 will corrrespond approximately to middle C). Three repeat controls which can be nested if required, and one subroutine. It should be noted that if a repeat is not required to be fully completed it can be aborted and play will continue from the relevant repeat character (F5, F7, or F9). This facility is also provided for the subroutine. Control EE will stop the program and should only be used at the end of the programme. Control EF will start the tape recorder and load in another set of data providing the NASCOM 1 has been modified for automatic control of the tape recorder. For the circuit of this modification see Fig. 2. I hope having mastered the principles here many of you will spend many enjoyable hours composing your own music or coding up your favourite tunes. Sound effects are a possibility that I have yet to explore. Perhaps the editor can be persuaded to publish odd 'tunes' from time to time.

and 'C' is on its own. Therefore by intelligent use of control all that need be written is A,B,C. The control characters dictating when each part is played. The second piece illustrated, FUER ELISE, uses all the control facilities and reduces a complicated FORM into a simple succession of themes. Studying this form will soon show my technique.



Overlay pattern for the port amplifier PCB.



The PCB foil pattern for the port amplifier.

ANALYSE NOTE CODE AND EXECUTE

```
0C50   1E 00              E=0
0C52   D9                 EXX
0C53   21 9F 0D           HL=0D9F
0C56   23          'M1'   INC HL
0C57   7E                 A , (HL)
0C58   FE ED              CP ED
0C5A   D2 91 0C           JNC 'CONTROL'
0C5D   F5                 PUSH AF
0C5E   E6 F0              AND F0H
0C60   CD 9F 0C           CALL 'T1'
0C63   7E                 A , (HL)
0C64   D9                 EXX
0C65   5F                 E , A
0C66   F1                 POP AF
0C67   E6 0F              AND 0FH
0C69   CD A5 0C           CALL 'T2'
0C6C   7E                 A , (HL)
0C6D   42                 B' , D'
0C6E   05          'M2'   DEC B
0C6F   28 04              JRZ 'M3'
0C71   CB 3F              SLR A
0C73   18 F9              JR 'M2'
0C75   D9          'M3'   EXX
0C76   57                 D , A
0C77   FE 00              CP=0
0C79   28 02              JRZ 'M4'
0C7B   3E 20              A=20H
0C7D   32 82 0C    'M4'   (0C82) , A
0C80   4A          'M5'   C , D
0C81   EE xx              XOR ?
0C83   D3 00              OUT 0 , A
0C85   F6 00       'M6'   OR 0
0C87   10 03              DJNZ 'M7'
0C89   1D                 DEC E
0C8A   28 CA              JRZ 'M1'
0C8C   0D          'M7'   DEC C
0C8D   20 F5              JRNZ 'M6'
0C8F   18 EE              JR 'M5'
```

ANALYSE CONTROL CODE AND SET REGISTERS

```
0C91   CD AB 0C           CALL 'T3'
0C94   6E                 L , (HL)
0C95   26 0D              H=0DH
0C97   01 9C 0C           BC=0C9CH
0C9A   C5                 PUSH BC
0C9B   E9                 JP (HL)
0C9C   C3 56 0C           JP 'M1'
```

TABLE CONTROL AND TABLES

```
0C9F   D9          'T1'   EXX
0CA0   21 B5 0C           HL=0CB5H
0CA3   18 0A              JR 'T4'
0CA5   D9          'T2'   EXX
0CA6   21 D3 0C           HL=0CD3H
0CA9   18 04              JR 'T4'
0CAB   D9          'T3'   EXX
0CAC   21 EF 0C           HL=0CEFH
0CAF   01 24 00    'T4'   BC=24H
0CB2   ED B1              CPIR
0CB4   C9                 RTN
```

INTERVAL TABLE 'T1'

```
0CB5   00 04              1/64
0CB7   10 08              1/32
0CB9   20 0C              3/64
0CBB   30 10              1/16
0CBD   40 15              1/12
0CBF   50 18              3/32
```

```
0CC1   60 20          1/8
0CC3   70 2B          1/6
0CC5   80 30          3/16
0CC7   90 40          1/4
0CC9   A0 55          1/3
0CCB   B0 60          3/8
0CCD   C0 80          1/2
0CCF   D0 C0          3/4
0CD1   E0 00          1

NOTE VALUE TABLE 'T2'

0CD3   00 00          Rest
0CD5   01 FF          A
0CD7   02 F1          A sharp / B flat
0CD9   03 E3          B
0CDB   04 D6          C
0CDD   05 CB          C sharp / D flat
0CDF   06 BF          D
0CE1   07 B4          D sharp / E flat
0CE3   08 AA          E
0CE5   09 A1          F
0CE7   0A 98          F sharp / G flat
0CE9   0B 8F          G
0CEB   0C 87          G sharp / A flat
0CED   0D 80          A octave

CONTROL CODE TABLE 'T3'

0CEF   EE 88          STOP
0CF1   EF 89          Reload from tape
0CF3   F0 13          Beginning of subroutines
0CF5   F1 15          Set octave '1'
0CF7   F2 15          Set octave '2'
0CF9   F3 15          Set octave '3'
0CFB   F4 15          Set octave '4'
0CFD   F5 1A          Repeat from F6 till end or
0CFF   F6 13          FB is found
0D01   F7 2C          Repeat from F8 till end or
0D03   F8 13          FC is found
0D05   F9 3A          Repeat from FA till end or
0D07   FA 13          FD is found
0D09   FB 48          See F6
0D0B   FC 52          See F8
0D0D   FD 5C          See FA
0D0F   FE 6A          Musical subroutine call
0D11   FF 7E          Musical subroutine return

CONTROL SUBROUTINES:
CONTROL F0, F6, F8, FA

0D13   D9          'F0A'  EXX
0D14   C9                 RTN

CONTROL F1, F2, F3, F4

0D15   EE F0          XOR F0H
0D17   57             D , A
0D18   D9             EXX
0D19   C9             RTN

CONTROL F5

0D1A   3E F6                 A=F6H
0D1C   CB 43                 TEST E , 0
0D1E   28 04                 JRZ 'F5A'
0D20   CB 83                 RST E , 0
0D22   D9                    EXX
0D23   C9                    RTN
0D24   CB C3          'F5A'  SET E , 0
0D26   D9             'F5B'  EXX
0D27   2B             'F5C'  DEC HL
0D28   BE                    CP (HL)
0D29   20 FC                 JRNZ 'F5C'
0D2B   C9                    RTN

CONTROL F7

0D2C   3E F8                 A=F8H
0D2E   CB 4B                 TEST E , 1
0D30   28 04                 JRZ 'F7A'
0D32   CB 8B                 RST E , 1
0D34   D9                    EXX
0D35   C9                    RTN
0D36   CB CB          'F7A'  SET E , 1
0D38   18 EC                 JR 'F5B'

CONTROL F9

0D3A   3E FA                 A=FAH
0D3C   CB 53                 TEST E , 2
0D3E   28 04                 JRZ 'F9A'
0D40   CB 93                 RST E , 2
0D42   D9                    EXX
0D43   C9                    RTN
0D44   CB D3          'F9A'  SET E , 2
0D46   18 DE                 JR 'F5B'

CONTROL FB

0D48   3E F5                 A=F5H
0D4A   CB 43                 TEST E , 0
0D4C   28 C5                 JRZ 'F0A'
0D4E   CB 83                 RST E , 0
0D50   18 12                 JR 'FDA'

CONTROL FC

0D52   3E F7                 A=F7H
0D54   CB 4B                 TEST E , 1
0D56   28 BB                 JRZ 'F0A'
0D58   CB 8B                 RST E , 1
0D5A   18 08                 JR 'FDA'

CONTROL FD

0D5C   3E F9                 A=F9H
0D5E   CB 53                 TEST E , 2
0D60   28 B1                 JRZ 'F0A'
0D62   CB 93                 RST E , 2
```

```
0D64   D9          'FDA' EXX
0D65   23          'FDB' INC HL
0D66   BE                CP (HL)
0D67   20  FC            JRNZ 'FDB'
0D69   C9                RTN
```

CONTROL FE

```
0D6A   3E  F0            A=F0H
0D6C   CB  5B            TEST E , 3
0D6E   28  06            JRZ 'FEA'
0D70   CB  9B            RST E , 3
0D72   E1                POP HL
0D73   E3                HL / (SP)
0D74   D9                EXX
0D75   C9                RTN
0D76   CB  DB            SET E3
0D78   D9                EXX
0D79   D1                POP DE
0D7A   E5                PUSH HL
0D7B   D5                PUSH DE
0D7C   18  A9            JR 'F5A'
```

CONTROL FF

```
0D7E   CB  5B            TEST E3
0D80   28  F2            JRZ 'FEA'
0D82   CB  9B            RST E , 3
0D84   D9                EXX
0D85   E1                POP HL
0D86   E3                HL / (SP)
0D87   C9                RTN
```

CONTROL EE

```
0D88   76                HALT
```

CONTROL EF

```
0D89   CD  7C  03        CALL 'LOAD'
0D8C   CD  3E  00        CALL 'CHIN'
0D8F   D9                EXX
0D90   21  9F  0D        HL=0D9F
0D93   C9                RTN
```

DATA STORAGE

From 0DA0

Minuet by G.F.Handel
Tempo ALLEGRETTO in the form AABB

```
F6  F3  B6  51  53  51  53  51
53  31  F2  3B  3D  F3  B8  51
53  51  53  51  53  31  F2  3B
3D  F3  CA  88  8A  8B  88  BA
88  8A  86  88  85  86  56  58
56  58  56  58  36  35  36  B8
86  85  83  81  B3  F2  B8  BC
DD  F5  F6  F3  B1  D6  B3  F2
8D  8B  8A  88  F3  B3  D8  B5
83  F2  8D  8C  8A  F3  B5  DA
B6  85  83  82  83  B5  F2  BA
F3  B2  E3  B1  BA  B1  F2  BD
8B  8A  BB  BB  F3  B8  F2  BB
BB  8A  88  BA  F3  BB  8A  88
86  85  83  F2  8D  8B  8A  88
86  B8  E1  B5  E6  F5
```

Silent interlude

```
F8  F6  E0  E0  E0  E0  F5  F7
```

Fuer Elise by Beethoven
Tempo POCO MOTO in the form AABABACABADABA

```
F0  F3  85  84  85  84  85  F2
8C  F3  83  F2  8D  8A  F1  85
8A  F2  81  85  8A  8C  F1  85
89  F2  85  89  8C  8D  F1  85
8A  F2  85  F3  85  84  85  84
85  F2  8C  F3  83  F2  8D  8A
F1  85  8A  F2  81  85  8A  8C
F1  85  89  F2  85  8D  8C  8A
FD  EC  F1  85  8A  FF  FE  F8
FA  F6  F2  8C  F3  81  83  85
F1  88  8D  F2  88  F3  86  85
83  F1  88  8C  F2  86  F3  85
83  81  F1  85  8A  F2  85  F3
83  81  F2  8C  F1  85  F2  85
85  F3  85  F2  85  F3  85  85
F4  85  F3  84  85  84  85  84
85  84  FE  F5  F3  81  81  81
F2  26  2A  DD  F3  96  55  B5
B3  9B  5A  8A  88  86  85  83
81  F2  BB  BA  1B  5A  58  5A
5B  DD  F3  83  84  C5  85  86
F2  8A  DD  F3  93  F2  5C  F6
F3  51  58  F2  58  F3  58  F2
5A  F3  58  F2  5C  53  58  51
58  53  58  55  58  5D  5C  5A
58  56  55  53  58  56  53  F5
55  56  55  54  F6  55  F2  5C
F3  55  54  F5  C5  F2  8C  F3
85  84  C5  F2  8C  F3  85  84
85  84  85  84  FE  F7  FE  BA
C0  30  F6  F3  D2  B2  D3  85
86  D6  B6  FB  D5  B5  D3  81
F2  8C  DA  BA  BA  BD  BC  EA
60  F5  D6  B6  D4  83  81  F2
DB  BA  D9  B9  DA  B0  BC  D0
F1  8A  F2  81  85  8A  F3  81
85  83  81  F2  8C  8A  F3  81
85  8A  F4  81  85  83  81  F3
8C  8A  F4  81  85  8A  BC  8C
8B  8A  89  88  87  86  85  84
83  82  81  F3  8C  8B  8A  89
88  87  86  FE  F9  EA  EE
```

Sits. Vacant

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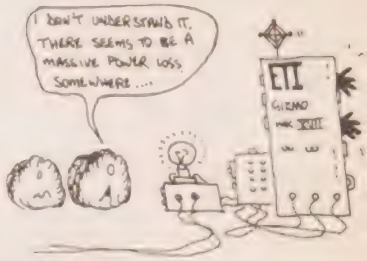

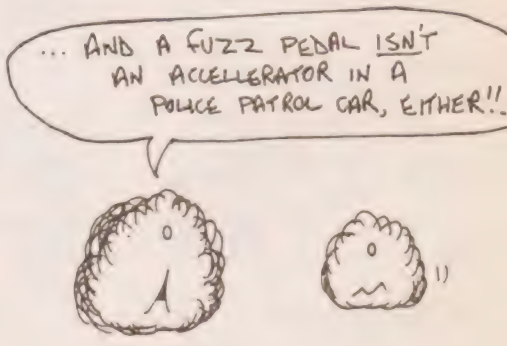

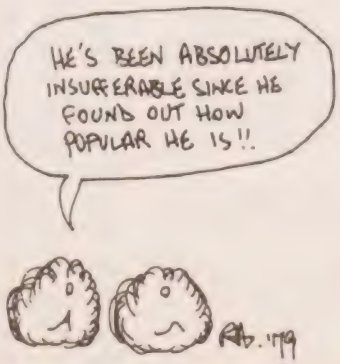

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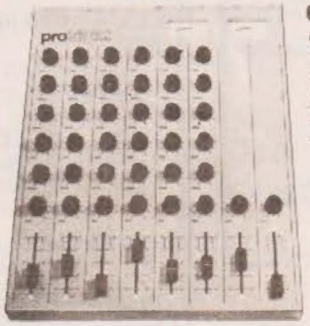

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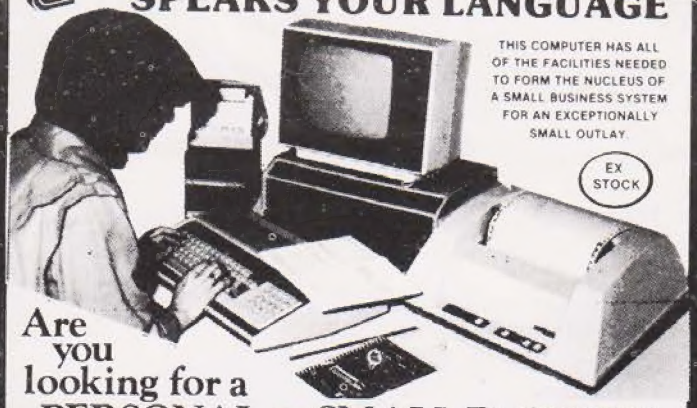

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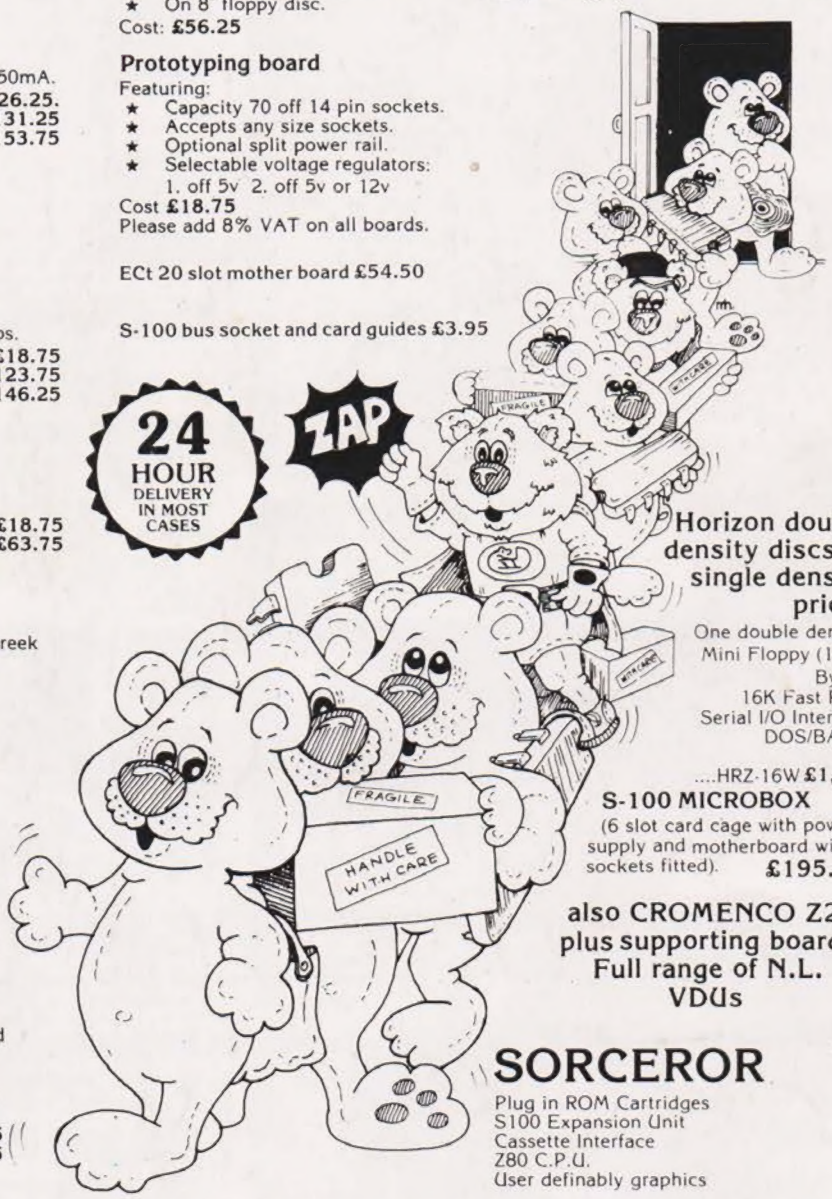

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